THURSDAY, NOVEMBER 19, 1891.

SCOTCH FISHERIES.

The Ninth Annual Report of the Fishery Board for Scotland: being for the Year 1890. (Edinburgh: Printed for Her Majesty's Stationery Office by Neil and Co., 1891.)

THIS, like the three preceding Reports, is published in three parts: I. General Report; II. Report on Salmon Fisheries; III. Scientific Investigations.

The first part deals with such matters as the statistics relating to fish landed and cured, Crown brands, number of boats and men fishing, an account of the services rendered by the various vessels employed in marine police and fishery superintendence; and generally, reports on all business matters connected with this section of the Board's work. The Shetland herring fishing seems to have been particularly successful, and to have attracted the usual number of English and Irish boats, but the reports as to the number of Scotch boats employed in this and long-line fishing tend to show that there is a gradual decrease; that the fishing does not now seem to hold out such attractions to the rising generation as it once did; that probably over-competition is telling upon this as well as other industries.

The chief article in the second part is the annual report of Mr. Archibald Young, Inspector of Salmon Fisheries for Scotland. It contains an account of the fishings in the various rivers and lochs, with answers to queries from district boards and local fishing authorities. The question of the advisability of having a close-time for trout is only casually mentioned; and we cannot but think that the Board would do well if, with all the facilities at its command, it paid more careful attention to such matters as the life-history and habits of the salmon. Many points of great interest and usefulness have still to be settled: for instance, we see no attempt to distinguish between the different "runs" of fish in the various rivers, their spawning periods, and subsequent movements. We are not told whether, in the case of the salmon hatcheries, any attention has been paid to the spawning of spring run fish—probably a point of great importance in early rivers. Might the Board not collect and publish much valuable information as to the best means of keeping up a steady supply of Salmonidæ, by looking at the question a little more with the interest of the naturalist and sportsman? A great deal of information is yet required as to late and early spawning, migratory movements of the young, rate of growth in the sea, food, &c. To carry out some of these inquiries might possibly require more legal power than the Board possesses, but that the Fishery Board is in a more favourable position than other fishery authorities will be generally admitted. These excellent reports as to the state of the salmon fishings should be used more as a means for improving that state than as the finished results of a year's inspection.

The third or scientific section of the Report is a volume of nearly 430 pages. The word *scientific* has, with the Fishery Board, a significance of its own: it covers a multitude of subjects, but is on the whole a convenient title. Part III. is subdivided into four sections. In the first (A.), after detailed tabulated results of the work done by means of the cruiser *Garland*, &c., there are one or two papers deserving of special mention.

A paper by Dr. Fullarton, "On the Suitability of Scottish Waters for Oyster Culture," is an exhaustive account of an expedition made by him to a great number of lochs on the west coast, and shows clearly that some of these lochs formerly produced an abundance of oysters, and have had, within recent years, an abundant fall of spat on their spawning beds. A table of temperatures and densities is also given, which is valuable, but would certainly have been much more so if the temperature readings had been given in the common Fahrenheit instead of the Centigrade scale. The next paper is by the Secretary for Scientific Investigations, Dr. T. Wemyss Fulton, on "The Capture and Destruction of Immature Sea Fish." The two most important parts of this paper deal with the vitality of trawled fish, and the numbers of immature fish taken by shrimpers. It is the first attempt ever made to collect accurate data as to the proportion of living and dead fish brought up in a trawl net worked upon a certain kind of bottom for a certain length of time. The information regarding the number of immature fish taken by shrimpers has been collected in the Solway Firth and on the Lancashire coast. The results cannot but be surprising to very many. Taking the Solway alone, Dr. Fulton's totals show that, in one year, a single boat captures over 110,000 immature plaice. It is gratifying to learn that in this district the fishermen are, for once, provident, and return to the sea all these little fishes, for the sum-total of all immature fish landed in the year, comes to about 3,653,000. Dr. Fulton finds that, owing to the short time the shrimp trawl remains at the bottom—a sandy bottom—none of the young fish die. This contradicts a statement very generally made by those who denounce the system of fishing with beam trawl, and also is exactly the reverse of the finding of MM. Giard and Roussin in their report on this subject to the French Minister of Marine—a report founded, however, not on experimental observation, as Dr. Fulton does not fail to point out. These observations further seem to show that very young fish caught in a shrimp trawl are much more tenacious of life than older fish taken in a large net of similar construction, and under similar conditions. This point, we think, is of some importance, and has not been sufficiently taken notice of. It bears on the question of size of mesh and destruction of small fish taken.

The biological section opens with a long paper, "On the Food of Fishes," by W. Ramsay Smith, B.Sc., and, following this, another paper by Dr. Wemyss Fulton, on "The Comparative Fecundity of Sea Fishes." In this paper the author first deals with the proportional weight of the ova compared to the rest of the body. This naturally leads him into the somewhat complicated subject of the proportion of eggs ripe at the spawning-time of certain fishes which do not shed their spawn *en masse*. He finds that in such cases it would often be an impossibility for the body of the fish to contain all the eggs it naturally produces in an enlarged and ripe condition. Taking

the instance of a plaice, it is shown that, if all its ova were ripe at once, the mass of eggs would themselves weigh a pound and a half heavier than the body of the fish without the ovaries.

Fish with demersal ova are distinguished from fish with pelagic ova, and tables are constructed which show the ratio of the weight of the ova present at one time, to the weight of the rest of the fish taken at 1000. The final results are given in the form of mean ratios. Dr. Fulton then goes on to draw three conclusions from his data. First, he says, it appears "to explain the majority of cases in which the females of a species are in excess of the males." What precisely explains this we are quite at a loss to see, and we cannot imagine an explanation which has not in it either a statement regarding the preponderance of the female element in the early nuclear plasma of the eggs, or an account of a wholesale destruction of males. The second point is the generally greater size of the female, and the third, "not merely the gradual growth of ova to replace mature ova shed during a prolonged spawning period, but the more or less sudden increase of bulk, which occurs in the ovum shortly prior to its extrusion." The second point seems to us to be like the first in requiring a more complete explanation; the third to be the clearest point advanced. The remainder of the paper is taken up with detailed statements, treating the fish according to their classification.

Among the papers following we have examples of Mr. Scott's conscientious systematic work in his second paper on "The Invertebrate Fauna of the Inland Waters of Scotland," and "Additions to the Fauna of the Firth of Forth."

Dr. Fullarton contributes a paper on "The Development of the Plaice—Preliminary Report." There are a number of excellent figures, but as there seems to be little that is new in the text, we do not give it further mention.

Prof. McIntosh adds to his already long list of observations "On the Life-Histories and Development of the Food and other Fishes." Interesting forms, such as a hybrid brill, lesser weaver, and sand-eel, are dealt with, as well as several unknown eggs and a curious unknown post-larval form.

Prof. Prince, so often associated with Prof. McIntosh, follows with "Notes on the Development of the Angler Fish (Lophius)."

In his statement that "hitherto no British observer has secured the ova," he has overlooked the fact that, in some previous notes by one of the naturalists to the Fishery Board, the procuring of a mass of ova was recorded. This, of course, in no way detracts from the interest of Prof. Prince's valuable paper.

The biological section closes with a note on "A Case of Hermaphroditism in a Haddock," by W. Ramsay Smith. Both ovary and testis appeared perfectly normal, and were removed from a fish 18 inches long, and 3 pounds in weight.

The physical investigations of the Board are dealt with by Dr. Mill in Section C.; and a review of the contemporary scientific fishery investigations, by Dr. Wemyss Fulton, forming a fourth section, brings the Report to a close.

THE MAMMALS OF INDIA.

Catalogue of Mammalia in the Indian Museum, Calcutta. By W. L. Sclater, M.A., F.Z.S., Deputy Superintendent of the Indian Museum. Part II. (Calcutta: Printed by order of the Trustees of the Indian Museum, 1891.)

THE Indian Museum at Calcutta is rich in Mammals. Not only are those of our Eastern possessions well illustrated, but it possesses also a good general series from other parts of the world. The collection has, moreover, the advantage of being well catalogued. In 1863, the late very zealous and acute zoologist, Edward Blyth, published a catalogue of the specimens contained in the Museum of the Asiatic Society of Bengal. This Museum, when transferred to the Government of India, formed the nucleus of the present Indian Museum. The 1330 specimens mentioned in that catalogue have now increased to 4872, representing 590 species, of which 276 are found within our Indian Empire, and 314 are exotic.

Of this greatly augmented collection Dr. John Anderson commenced a catalogue, and the first part, containing the orders Primates, Prosimiæ, Chiroptera, and Insectivora, was published in 1881. In consequence of Dr. Anderson's relinquishing his appointment as Superintendent of the Museum, the work has remained in abeyance for some years; but it has now been taken up and completed by Mr. W. L. Sclater, the present Deputy Superintendent, and eldest son of the distinguished Secretary of the Zoological Society of London. This volume contains the orders Rodentia, Ungulata, Proboscidea, Hyracoidea, Carnivora, Cetacea, Sirenia, Marsupialia, and Monotremata.

The Mammals of our Indian Empire have attracted the attention of many well-qualified zoologists. Hodgson, Blyth, Jerdon, Tickell, Horsfall, Elliot, Dobson, Anderson, and others, have contributed much to elucidate their history, habits, and distribution. The work now being published under the auspices of the Indian Government by Mr. W. T. Blanford, the first part of which appeared in 1888 (see NATURE, vol. xxxviii. p. 513), contains a valuable summary of all that is known upon the subject up to the present time. Mr. Sclater's work is of a less ambitious kind, professing to be only a catalogue of the Mammalia contained in the Museum, not mentioning any other species. Such catalogues are not only invaluable for working purposes in the institution itself, but they have also a more extended area of usefulness, being often works of reference which no zoologist investigating the group they treat of can dispense with. In the present case there will be found under the heading of every species much information as to its literature, synonymy, and geographical distribution. As catalogues naturally deal largely with names, the selection of those which accord best with a common-sense interpretation of the rules of zoological nomenclature is a matter of primary importance, and in this respect Mr. Sclater appears to have shown upon the whole great judgment, having been careful to avoid unnecessary alterations in generally accepted names, either such as are caused by splitting genera, or by reviving obsolete, long-forgotten, or never received specific appellations. Although no de-

tailed specific descriptions are attempted, the work is rendered more useful than a mere list would be, by the introduction of keys, by means of which all the Indian species can be discriminated. There are also some critical remarks upon disputed questions of specific distinction, which the large series of specimens at the author's disposal has enabled him to throw light upon, such as the identity of *Ovis poli* of the Pamir and the so-called *Ovis karelini* of the Thian Shan. Under the heading *Elephas indicus*, we note that Mr. Sclater refers to Schlegel's having pointed out in a well-known memoir (of which a translation appeared in the *Natural History Review*, vol. ii., 1862) certain distinctions between the true Indian elephant and that inhabiting the islands of Ceylon and Sumatra (*Elephas sumatranus*, Schlegel), and he repeats the characters assigned to the two supposed species or varieties. Although no fresh evidence is brought forward in favour of Schlegel's views, it is not likely that Mr. Sclater would, without good reasons, reject Dr. Falconer's elaborate refutation of them, published in the succeeding volume of the same Review. Dr. Falconer was such a great authority on elephants, and his arguments for the specific unity of the Asiatic forms have been so generally held to be sound, that Schlegel's two species can only be rehabilitated by a careful comparison of a considerable series of specimens undoubtedly natives of both localities. Perhaps Mr. Sclater may have an opportunity of doing this while in the East, and thus definitely settle a question of considerable zoological interest.

W. H. F.

A TEXT-BOOK OF CHEMICAL PHYSIOLOGY AND PATHOLOGY.

A Text-book of Chemical Physiology and Pathology. By W. D. Halliburton, M.D., B.Sc., M.R.C.P. (London: Longmans, Green, and Co., 1891.)

IN spite of the fact that several standard works on the subject of physiological chemistry exist, both in German and English, the need has nevertheless been universally felt of one that should at the same time present a review of the present condition of the subject from an impartial standpoint, and give some account of the methods of research employed.

Hoppe Seyle's works have been of immense service, but suffer from being onesided, and representing only the views and methods of the Strassburg school. The only work in English which promised to be universal in its scope—namely, that by Gamgee—is unfortunately still unfinished.

Prof. Halliburton, who is justly celebrated for his work in all departments of physiological chemistry, has attempted to fill this gap in our literature, and with a large measure of success.

The first fifty pages of the book are taken up with an account of the apparatus and analytical methods chiefly employed in physiological chemical research. The only fault we have to find with this part of the book is that there is not enough of it. In a book intended as a guide to those who would work practically at the subject one hundred and fifty pages might well be devoted to these subjects, seeing that so many workers boldly attack the chemical problems of physiology with scarcely any practical knowledge of chemical analytical methods.

The second part treats of the chemical constituents of the organism, concluding with two chapters on fermentation and ptomaines, the chapters on the latter and on proteids being especially good, and presenting an excellent *résumé* of our present knowledge of these subjects.

The next section is taken up with an account of the tissues and organs of the body. Here the author is thoroughly at home, and can speak with the authority of many years' practical work at the subject. It is rather difficult, however, to see on what principle he includes respiration in this part, especially as the subjects of alimentation, excretion, and general metabolism have each a part to themselves; unless it be, that it is so intimately connected with the physiology of the blood. In this chapter a student might be led astray by seeing the table of relations between the tension of the gases in venous blood and of those in the alveolar air. The important thing to know is the tension of gases in arterial blood; and by giving those in venous blood in juxtaposition to those in the alveolar air, the author glosses over the difficulties presented by the question of gas interchange in the lungs. In this connection, too, he does not notice Bohr's important work on the subject (interchange of gases in the lungs), although he gives a full account of the Danish physiologist's researches on the combination of hæmoglobin with CO_2.

In the latter part of the book no reference is made to Altmann's views on fat absorption, or to Ehrlich's suggestive work on the oxidative processes taking place in living tissues.

But a few errors of omission are inevitable in a work of this size and scope, and Dr. Halliburton wins our admiration for the completeness and correctness of his book, which everywhere shows signs of the care with which the proof-sheets have been revised and brought up to date. The accounts of recent analytical methods and work render it invaluable in a physiological laboratory, and it will be repeatedly referred to by students who desire more than a superficial knowledge of the subject. In Germany it has already found favour with physiologists, and is considered the best work on the subject. The fact that it is being translated into German, under the auspices of Prof. Kühne, is of itself sufficient recommendation for any work; and there is no doubt that in its new dress it will command as much success in Germany as it has already commanded in England.

E. H. STARLING.

OUR BOOK SHELF.

Praktisches Taschenbuch der Photographie. By Dr. E. Vogel, Assistant in the Photochemical Laboratory of the Technical High School of Berlin. (Berlin: Robert Oppenheim, 1891.)

THIS is a small volume, of some 200 pages, but it is full of useful information for working photographers, whether amateurs or professionals. Under nine sections the author treats of all the subjects likely to be required by the manipulator of the camera, from the purchase of his apparatus onward through every detail essential for successful work. The value of the book is greatly enhanced by numerous illustrations, which are

executed with that clearness and finish for which so many Continental scientific works are justly to be commended. To give an idea of its contents it will be sufficient to mention the headings of the sections, viz. apparatus for the negative process, photographic objectives, instantaneous shutters, portable cameras, equipment of the dark room, general remarks on exposure, negative processes, positive processes, cyanotype and similar processes. The work, as its title implies, is purely technical, and, as such, does not call for lengthened notice in these columns, but for the particular object with which it has been written it is admirably adapted, and should find many readers in this country. We have nothing which can be compared with it for conciseness and completeness.

An Introduction to the Differential and Integral Calculus. By T. Hugh Miller. (London: Percival and Co., 1891.)

THIS small book contains a fair amount of the calculus put together in a clear and readable form. It merely touches the subject, but appears to contain enough to meet the wants of a South Kensington examinee. "It assumes a knowledge of elementary algebra and trigonometry as far as the properties of plane triangles." The student is supposed to be unacquainted with analytical geometry, but as he is credited with a knowledge of the exponential and binomial theorems, with "indeterminate coefficients" and a few other matters, it will be seen that *elementary* includes a fair grasp of the two subjects named. Six chapters are devoted to the elements, successive differentiation, the theorems of Leibnitz, Taylor, and Maclaurin, maxima and minima values of a function of one variable, and the evaluation of indeterminate expressions; the remaining four chapters are devoted to elementary integration, formulæ of reduction, rational fractions, and a few applications of the integral calculus. We presume that the miscellaneous examples are taken from South Kensington papers; those in the text are old friends which figure in Todhunter's works. In the text. the following slips occur: p. 4, l. 15, for $f(x)$ read $f'(x)$; p. 18 (6), read e^{x^3}; p. 37 (3), for $\frac{x^6}{720}$ we get $\frac{x^6}{5}$; p. 40 (3), ? $(a-b)^2/a$ for the maximum; p. 41, l. 4 up, for $2a+3b$, read $3a+2b$; p. 42 (1), read $\cos^3\theta$ and $3\sqrt{3}d^2/16$; p. 62 (4), ? last connecting sign (read $-$); p. 71 (4), for π read π^2; p. 80 (24), in first place read $(1+x^2)^2$. In the answers, we differ from the author in (1), (20), (74), and (88). We prefer to work (84) from $\int (1+t^2)^{\frac{3}{2}} dt$, where t stands for $\tan x$.

Star Groups. By J. Ellard Gore. (London: Crosby Lockwood and Son, 1891.)

A KNOWLEDGE of the principal constellations visible in our latitudes may be easily acquired from the thirty maps and accompanying text contained in this work. All stars down to the sixth magnitude are shown, and brief descriptions given of the objects of interest in each constellation. The maps are intended to be useful as an introduction to larger atlases, and will doubtless serve this purpose well; but a beginner unacquainted with the motions of the heavenly bodies will hardly find in them what he requires. G.

The Universal Atlas. (London: Cassell and Company, 1891.)

THIS atlas is being issued in twenty-eight parts, including the index, eight of which have already appeared. It contains fifty-eight single page maps and thirty-two double page, several illustrating physical geography. The maps are well drawn and reproduced, and full of detail, whilst their large scale has enabled the names of all places of any importance to be printed with perfect legibility. In fact, all who require a good atlas, for reference or otherwise, would do well to obtain this one. G.

La Transcaucasie et la Péninsule d'Apchéron. Calouste S. Gulbenkian. (Paris: Hachette et Cie., 1891.)

THIS is a very pleasant book of travels, well worthy of the attention of all who for any reason take interest in the Caucasus. The author has no very stirring adventures to tell us of, but he presents lucid and attractive descriptions of the towns and districts through which he passed, and of the manners and customs of the inhabitants. Especially good are the chapters he has devoted to the petroleum industry—chapters which have already appeared in the *Revue des Deux Mondes*. He gives also a very interesting account of Oriental carpets, the manufacture of which plays so great a part in the Caucasus.

How to Organize a Cruise on the Broads. By E. R. Suffling. (London: Jarrold and Sons, 1891.)

IN preparing this little book, the author did not attempt to provide a guide to the Broads. He intended the volume to serve merely as a supplement or appendix to the various guides already accessible. A cruise on the Broads is heartily enjoyed by everyone who tries it under tolerably favourable conditions, and certainly not least by students of natural history. Anyone who may think of making the experiment will find in Mr. Suffling's pages all the information that is really necessary for the formation of suitable plans. In one chapter he presents a brief and interesting diary of what may be looked for at the Broads during the various months of the year.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Difficulty in Weismannism.

I HAD intended to accept Prof. Hartog's challenge, and say a few words on this subject at an earlier date, but absence from home and many engagements have interfered until now.

In some respects it would have been more convenient to defer such a discussion until Weismann's last essay, "Amphimixis," has become more widely known, or even until the appearance of his complete and detailed work, which is expected some time next year. Prof. Weismann tells me that the points raised by Prof. Hartog are considered in this treatise, and, such being the case, he is unwilling to tax his already over-strained eyesight with any earlier reply.

As the question has been raised, I will briefly speak of the manner in which I have tried to see my way through such difficulties. I do not, however, wish to involve anyone else in the responsibility for the attempt, which is no doubt crude and insufficiently thought out.

Accepting Prof. Hartog's five theses as fair statements, I have always proceeded to make his hypothesis B, and in this I believe I am following Prof. Weismann. Hypothesis A had never occurred to me, and I agree with Prof. Hartog in considering it as valueless But I believe a way through the difficulties raised against hypothesis B may be found in the assumption of a relationship between the Ahnenplasmas in the germ-cell. Such a relationship is perhaps hinted at by Prof. Hartog in Thesis III., where he speaks of these units as lying "associated together," and in this respect the metaphor of two packs of cards in Thesis IV. is, I believe, inadequate. I have always been accustomed to regard the relationship between the ancestral units, the "pattern" or figure which they form, as an essential part of the process. I have regarded the units as the necessary material, like the pigments in a colour-box, while their arrange-

ment would correspond to a finished picture. With such a conception I should prefer in Thesis IV. the metaphor of a kaleidoscope. The pattern at any one point will determine the pattern that succeeds, although, with an infinite number of pieces, the latter must always be different. But though differing, the successive patterns will resemble each other far more closely than those which are separated by wide intervals. Similarly, I do not think it is inconceivable that the arrangement of the ancestral units may have a determining effect on the arrangements which will succeed, in spite of the loss and restoration of half the units in each generation. Such a conception has the further advantage that it renders intelligible the action of external conditions on the germ-cells, either directly or through the medium of the body-cells. The ancestral units may be excessively stable, but the arrangements may be modified by a shock, just as the pattern in a kaleidoscope may be changed by a blow instead of the "normal" process of rotation (corresponding, of course, to the loss and restoration of half the units).

Oxford, November 16. EDWARD B. POULTON.

Town Fogs and their Effects.

THE influence of fogs on health, referred to in the very interesting paper by Dr. Russell (NATURE, November 5, p. 10), seems to call for further investigation. On the face of it, and judging by the composition of fogs, the discomfort they bring, their hurtfulness to plants, &c., fogs must surely damage health. And the injurious effect, I would point out, might not be *at once* apparent in the death-rate. What, on the other hand, is the precise nature of the beneficial effect of fogs (for such there seems to be)? If they plague mankind, they probably also plague those enemies of mankind, the minute organisms on which disease depends. And if so, we might even suppose some lives to be saved when fog comes on. It would be interesting to hear from hospitals for special diseases, how the patients are affected by fog. I understand that people suffering from asthma often rather enjoy a fog, or the sulphureous atmosphere of the Underground Railway. Has this ever been explained? M.

The Eclipse of the Moon.

I VENTURE to send some notes upon last night's eclipse of the moon, taken by me here up to 11.35 p.m., when the sky became rather suddenly and entirely overcast.

The first indication of the penumbra of the earth's shadow was distinctly visible upon the north-east limb of the moon a little before 10.25; and at 10.35 (time given by the almanac) her north-east limb was well in shadow, and hidden by a remarkably dense or black shadow. At this time the sky here was quite clear, and promised to keep so for some time. At 10.45 the shaded part of the moon was so dark as to be invisible upon the sky even through glasses. At 10.50 a very beautifully coloured prismatic "cock's eye" formed in the sky exactly opposite the shaded limb, taking a fan-like shape radiating from that side of the moon; the prismatic colours being repeated twice, as in a double quadrant of a rainbow; while the sky round the bright part of the moon was clear and uncoloured. At 10.55 a thin white cloud, with ring of prismatic colours, formed round the moon; the earth's shadow still remaining very dark, with well-defined edge, and little or no penumbra beyond it. At 11.5 the thin cloud entirely cleared, the shadow still very dark, the upper and lower edges of the moon's limb just visible as threads of light upon the sky; and at 11.10 a very slight warmish tint appeared about the north-east part of shadow. At 11.15 the sky very clear and dark about the moon, stars before invisible coming out brightly. The earth's shadow was now well advanced over the moon, strongly defined, and as dark as the sky beyond it. At 11.22 light thin clouds again gathered round the moon, a narrow crescent of her only remaining. At 11.25 the moon became wholly hidden by a dense cloud. At about 11.35 I caught a momentary glimpse of the moon through the cloud, a very small part of her south-west limb just showing. At 11.40 sky entirely overcast; a faint aurora or red colour spreading upward, apparently below this cloud or mist, from the north.

I have only to add that the *darkness* and *absence of colour* of the shaded part of the moon was even more marked in this eclipse—so long as I was able to observe it—than in that of October 4, 1884, which was then set down to an abnormal density of the earth's atmosphere, and was supposed to have some connection with the strange sunsets and other phenomena of that period. I was not altogether unprepared for the same general character in last night's eclipse, as, so far as my own observations go, I am led by them to believe that the conditions then present in our atmosphere are still with us.

Southampton, November 16. ROBERT C. LESLIE.

Comparative Palatability.

THE following observations were made during the last week of September and first of October:—

Two tadpoles of the small newt were taken by a "silver-fish." Three others, placed next day in the globe containing this fish and two goldfish, were not swallowed, though attempted from time to time. A brandling (*Allolobophora fœtida*) was once taken by the same silver-fish; but refused the next day and afterwards.

A large frog (♀) ate brandlings readily. Two slugs were taken by frogs. Tadpoles of the small newt were disregarded.

A very interesting experiment was made with a brimstone butterfly (*Rhodocera rhamni* ♂). It was offered to a frog which had just taken a *V. urticæ*. Though fairly seized several times, the brimstone was always rejected. After one rejection, a second *V. urticæ* was swallowed; after another, a *Spilosoma* larva. The butterfly was then given to a spider, which attacked it, but left it unwound. A *V. urticæ* placed in the web was at once seized, partially wound, and sucked. Then the spider returned to the brimstone; but immediately left it again for the *Vanessa*, which was thoroughly wound, sucked, and moved higher up into the web. At dusk, the brimstone had been very imperfectly fastened. Next morning, however, it had been taken up by the spider.

That a frog is not much hurt by the nippers of *Ocypus* is shown by the following experiment. A specimen which had been taken from the side seized the frog's tongue, was rejected after a few minutes, and removed by the forceps. The frog immediately after took a large earthworm.

Small frogs are exceedingly bold and voracious; often attacking prey which is as large as themselves, and which they could not possibly swallow. House- and harvest-spiders, hairy and smooth larvæ (among them those of *Spilosoma* sp. and *Mamestra persicariæ*), ladybirds, earthworms, brandlings, and silver-Y moths, were all swallowed somehow; while large "devil's coach-horses" were invariably attacked. Tadpoles of the small newt were disregarded. E. B. TITCHENER.

Inselstrasse 13, Leipzig.

The Inheritance of Acquired Characters.

WILL you allow me to call the attention of your readers to a sentence in Mr. Hemsley's review of Schimper's and Karsten's works on the mangrove vegetation? "Mangroves grown in soil free, or practically free, from chloride of sodium, develop foliage of less substance, furnished with a larger number of stomata." If this means, as I understand it, that the change takes place immediately with the change in the conditions of growth, it would be very interesting to have further details; as the fact would furnish a very strong argument that the peculiarities in the mangrove vegetation are the result of the inheritance of acquired characters. ALFRED W. BENNETT.

St. Thomas's Hospital, November 7.

"The Darwinian Society."

IN your issue of November 5 (p. 19) information is given that a local Society is about to be inaugurated in Edinburgh, under the title "The Darwinian Society."

As the Society is apparently to be merely for the encouragement of the study of natural science in the University of Edinburgh, the name is surely too pretentious to be suitable; and it is one that might well, I think, be kept in reserve for bestowal in later years upon a chartered Society of similar magnitude and as far-reaching extent as that founded in honour of Linnæus. It is therefore to be hoped that a more applicable name than the one proposed may be found for the new Edinburgh University Society. WILLIAM WHITE.

Sheffield, November 10.

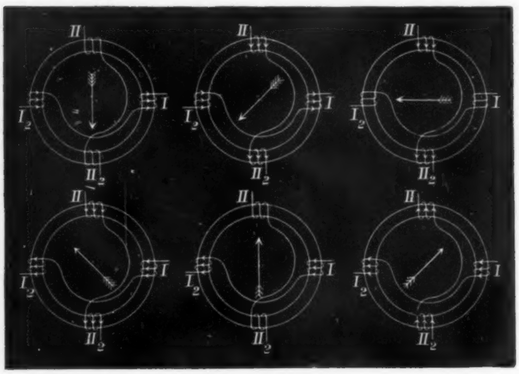
SOME NOTES ON THE FRANKFORT INTERNATIONAL ELECTRICAL EXHIBITION.[1]

V.

The Evolution of the Multiphase Alternate Current Motor.

THE two-phase alternate current motor described in Part IV. has the disadvantage that, not merely does the magnetic field rotate, but it also varies in strength: this causes the driving force to fluctuate, and diminishes the power that the motor would otherwise give out. That there is this variation in strength of the magnetic field

a *b* *c*



d *e* *f*

FIG. 12 (repeated).—Rotating magnetic field produced by two alternating currents, differing by 90° in phase.

may be seen from Fig. 17, where the continuous curves I and II show at any moment the strengths of the currents in the coils I and II, Fig. 12 (repeated for reference from the last article); while the dotted curves I_2, II_2, in Fig. 17, give the values at any moment of the currents in the coils I_2, II_2, in Fig. 12. For example, when the time equals *a* (Fig. 17), the currents flowing in all the four coils will always help one another to magnetize the iron ring, hence the magnetizing force at any moment will be approximately proportional to the number of convolutions in one of the coils multiplied by the *arithmetical* sum of the ordinates of all the four coils I, II, I_2, and II_2, that is, multiplied by twice the ordinate of the upper or summation curve.

If the maximum ordinate of either of the curves I or I_2 be called H, the ordinate of the upper or summation curve is equal to H when the time is *a*, *c*, or *e*, corresponding with the illustrations marked *a*, *c*, and *e* in Fig. 12; whereas the ordinate of this summation curve is $\frac{2}{\sqrt{2}}$ H, or 1·414H, when the time is *b*, *d*, or *f*, corresponding with the illustrations marked *b*, *d*, and *f* in Fig. 12.

Hence, if K be the number of convolutions in one of the coils, the sum of the products of the current into the number of convolutions, or the *number of ampere-turns*, as it is called, will vary between two values proportional to HK and 1·414 HK—that is, will vary by 41·4 per cent. The variation in the magnetism produced by such a change in the number of ampere-turns will be less than 41·4 per cent., and much less if the magnetic induction be considerable; still, the fluctuation in the strength of the rotating field may be greater than is desirable.

If in place of the two pairs of coils (Fig. 12) there be three, I, I_2, II, II_2, III, III_2, as in Fig. 18, and if the alternating currents passing through these three circuits be of the same maximum altitude and periodic time, but differ by 60° in phase, the variation in the number of ampere-turns will be much less than if only two alternating currents be employed. For on examining the sum of the ordinates of the three continuous curves, I, II, III (Fig. 19), which are the curves of three such currents, we see that the sum, or the ordinate or the top curve, varies between 2H sin 60°, when the time equals *t*, and H + 2H sin 30°, when the time equals *t*. Hence this sum varies between $\sqrt{3}$H and 2H, corresponding with a change of only 14 per cent. in the magnetizing force, and with less than 14 per cent. in the magnetism produced.

Such a system, however, would require six wires, whereas the same reduced maximum variation of the number of ampere-turns can be practically attained by employing only three wires conveying three alternate

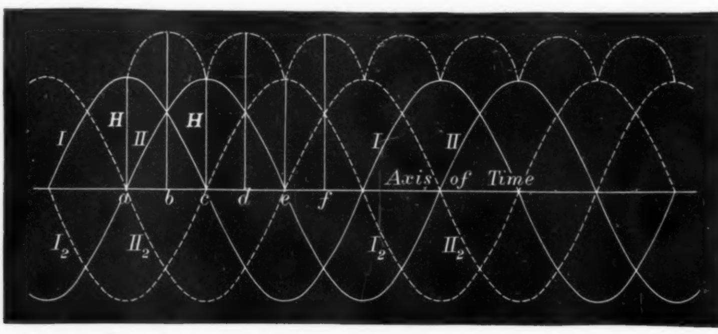


FIG. 17.—Two harmonic alternating currents of the same period and maximum amplitude, but differing by 90° in phase.

the coils I and II have respectively their maximum value and nought; whereas when the time equals *b*, the currents flowing in each of these coils is the same, being equal to 2 × sin 45° into the maximum value.

Now if each of the four coils occupies only a small portion of the ring, as shown in Fig. 12, the currents in currents differing by 120° in phase, and by joining up the motor as shown in Fig. 20.

That it is possible to use only three wires, so that either wire always acts as the return wire for the currents in the other two, arises from the fact that the algebraical sum of three harmonic alternate currents of the same period and maximum amplitude but differing by 120° in

[1] Continued from vol. xliv. p. 619.

phase is always nought. This may be easily proved thus: the values of three such currents are given at any moment by projecting on a stationary line, POQ (Fig. 21), the three equal limbs of the three-legged figure $O\alpha$, $O\beta$, $O\gamma$, as it rotates with uniform velocity round the point O. $O\alpha$, $O\beta$, $O\gamma$, are, therefore, the maximum values of the three currents, and the actual values of the currents for the position of the figure shown are OA, OB, OC, respectively, corresponding in relative magnitude with the lengths of the arrows which are attached to A, B, C. in Figs. 18 and 20, and in direction with the arrows attached to the latter figure, on the assumption that a current is regarded as positive when it circulates round the iron ring in such a direction as to tend to send a north pole counter-clockwise round the iron ring. Now the sum of the projections on POQ of any three lines $O\alpha$, $O\beta$, $O\gamma$ (Fig. 22) is simply the projection of $O\zeta$ found by drawing $\alpha\epsilon$ and $\epsilon\zeta$ parallel and equal to $O\beta$ and $C\gamma$ respectively. But if such a construction be made for Fig. 21, ζ and O will always coincide, therefore the sum of the projections of $O\alpha$, $O\beta$, and $O\gamma$, Fig. 21, must be always nought.

Fig. 23 shows three curves, I, II, III, drawn so as to give the values at any moment of three harmonic alternating currents each of the same altitude, H, and periodic time, but differing by 120° in phase, and it is seen that the sum of the three ordinates—that is, the ordinate of the top curve—varies from $H + 2H \sin 30°$, when the time equals t, to $2H \sin 60°$, when the time equals t', so that the ordinate of the summation curve varies from 2H to $\sqrt{3}H$, corresponding with a variation of 14 per cent. But this is exactly the variation that we obtained in Fig. 19, hence if there be twice as many convolutions in each of the three coils of Fig. 20, as in each of the six coils of Fig. 18—that is, the same total number of coils in the whole ring—and if the three equal harmonic alternating currents differing by 120° in phase have each the same

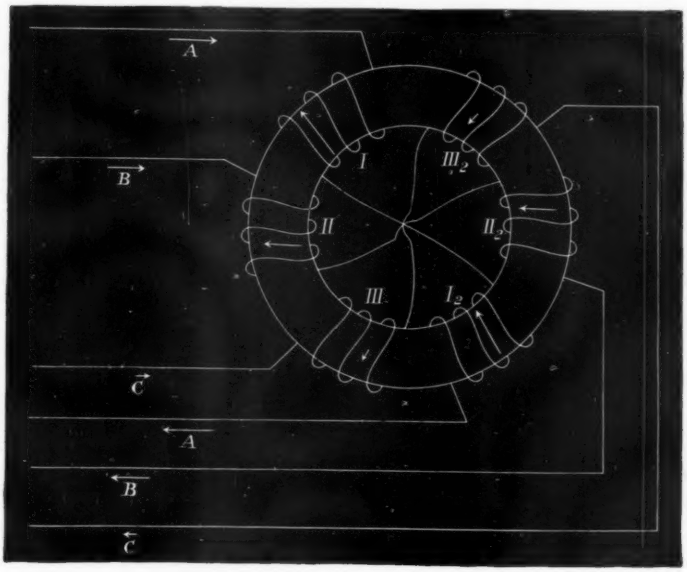


FIG. 18.—Currents differing by 60° in phase, and represented in direction and magnitude by the direction and length of the arrows.

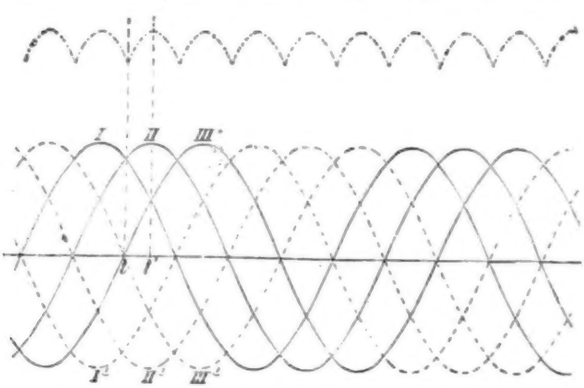


FIG. 19.—Three harmonic alternating currents of the same period and maximum altitude, but differing by 60° in phase.

maximum amplitude as the three equal harmonic alternating currents differing by 60° in phase, there will be the same maximum variation in the number of ampere-turns in the two cases.

Mr. Dolivo Dobrowolski, the designer of the three-phase motor employed in the Lauffen-Frankfort transmission, was the first to draw attention to this variation in the number of ampere-turns with a rotatory magnetic field motor, and the pulsation of the field thus produced. But we venture to think that in his deductions he lays too much stress on the mere variation in the number of ampere-turns, and too little on the fact that the variation in the number of ampere-turns only imperfectly indicates the variation in the strength of the rotating field. That the one variation does not alone measure the other arises first from the induction in iron not being, as is well known, proportional to the magnetizing force; secondly, from the magnetic leakage in the motor being different when the axis of the rotating field cuts the ring between two of the coils, and when it passes through a coil conveying a current, a case which cannot, of course, be neglected when each coil occupies a considerable portion of the ring, as in an actual three-coil motor.

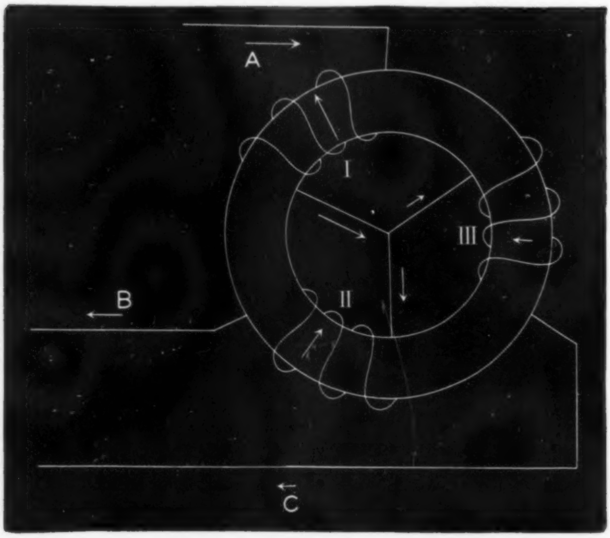


FIG. 20.—Three-phase alternate current motor (open winding); currents differing by 120° in phase, and represented in direction and magnitude by the direction and length of the arrows.

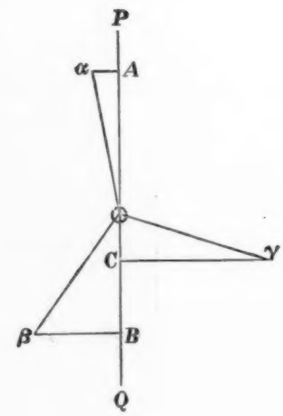


FIG. 21.

Hence we doubt whether it could be decided theoretically without experiment with which of the windings indicated in Figs. 12 or 20 the rotating magnetic field would undergo the greater variation in strength, if in both cases the windings occupied the whole of the iron ring.

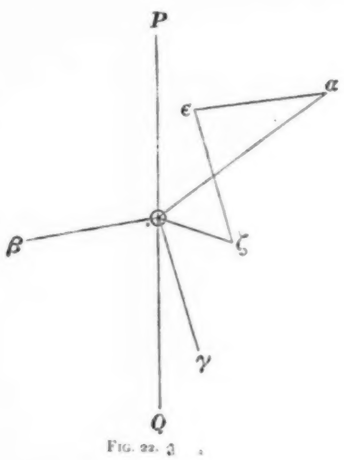


FIG. 22.

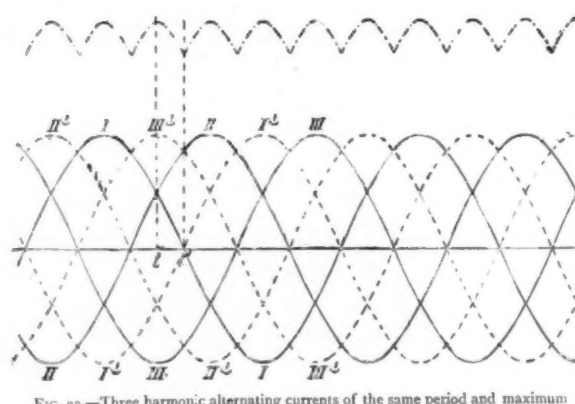


FIG. 23.—Three harmonic alternating currents of the same period and maximum altitude, but differing by 120° in phase.

Since, as we have proved, the algebraical sum of the three alternate currents in the coils I, II, III, Fig. 20, is always nought, Kirchhoff's second law suggests that these

three coils, instead of being wound on the ring as indicated in Fig. 20, may be wound so as to form a closed circuit, as shown in Fig. 24. With this arrangement of coils it is easy to show that the current

$$\text{in I} = \frac{A+B}{3},$$

$$\text{,, II} = \frac{B-C}{3},$$

$$\text{,, III} = \frac{C+A}{3},$$

where A, B, and C represent simply the arithmetical values of the currents in the three main leads. And in Fig. 24 the arrows attached to the wires A, B, and C, and to the coils I, II, III, are drawn of such proportional lengths that the above connection between the currents

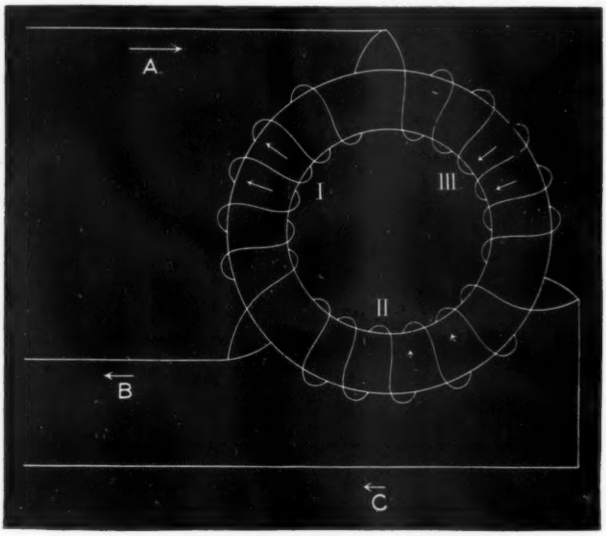


FIG. 24.—Three-phase alternate current motor (closed winding); currents differing by 120° in phase, and represented in direction and magnitude by the direction and length of the arrows.

in the three coils and the currents in the three mains is satisfied.

Next, to find the difference in phase, we draw three lines, so that their projections on POQ (Fig. 25) represent in direction and magnitude $\frac{OA+OB}{3}$, $\frac{OB-OC}{3}$, $\frac{OC+OA}{3}$, which is done by taking one-third of the diagonals of each of three parallelograms constructed respectively on Oα and Oβ *produced backwards*, on Oβ and Oγ *produced backwards*, and on Oγ and Oα *produced backwards*. In this way is obtained the three-legged figure, O1, O2, O3, with three equal sides making angles of 30° with Oα, Oβ, Oγ, respectively; then O I, O II, and O III, the projections of O1, O2, and O3 on POQ, give us the direction and magnitude of the three currents in the coils I, II, III (Fig. 24). Hence we see that the current in coil I lags 30° behind the current in A, the current in coil II 30° behind the current in B, and similarly the current in coil III 30° behind the current in C.

Since the three coils both for the open and the closed methods of winding (Figs. 20 and 24) are connected together, and since the current in any one coil varies like the current in the preceding coil, with a lag of 120°, each value of the current may be regarded as travelling round the ring from each coil to the next. This idea has led Mr. Dobrowolski to call such a motor a rotatory current or "*drehstrom*" motor.

In joining up a three-phase *drehstrom* motor, we have to decide whether we shall adopt the arrangement shown in Fig. 20 or that illustrated in Fig. 24. The latter, or closed winding, would be employed when we desired that the maximum potential difference between the terminals of any one of the three coils should be equal to the maximum potential difference between any two of the mains; while with the open method of winding (Fig. 20) the maximum difference of potential between the terminals of any one of the three coils would be only $\frac{1}{\sqrt{3}}$, or 0·5744

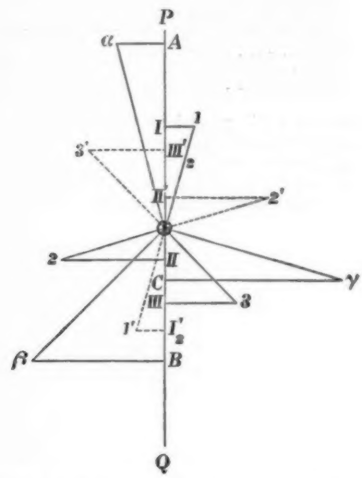


FIG. 25.—Projections of Oα, Oβ, Oγ give direction and relative magnitude of currents in the mains A, B, C of Figs. 20, 24, 27, 29, and 31, and of currents in coils I, II, III of Fig. 20. Projections of O1, O2, O3 completely represent currents in coils I, II, III of Fig. 24; and projections of O1, O2', O3 completely represent currents in coils I, II, III of Fig. 27.

times the maximum potential difference between any two of the mains. The open method has the further advantage that the middle point where the single current branches into two (Fig. 20) can be permanently connected with the earth; so that, while the maximum potential difference between each pair of mains may be, say, 20,000 volts, the potential of no point of the whole system can ever differ from that of the earth by more than 10,000 volts, a result which of course enables the insulation of separate aërial conductors to be more easily carried out.

The open method of winding has therefore been adopted for the transformers at Lauffen and at Frankfort, as well as for the motor at Frankfort; but, for the reasons which follow, the actual winding employed is more complex than that indicated in Fig. 20.

In addition to the defect possessed by the two-phase alternate current motor arising from the variation in the strength of the rotating magnetic field, there is another defect caused by the rotation of the field not proceeding

at a uniform rate, so that the driving force is intermittent. Both these defects, however, can be much lessened by subdividing up the coils wound on the iron ring of the motor, a result that can be attained without increasing the number of main wires beyond three by employing the following device. Imagine one half of each of the three coils of

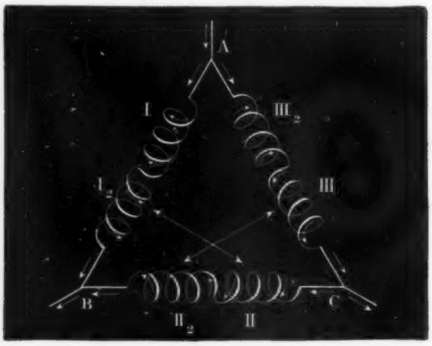


FIG. 26.—Transformation of a three-phase alternate current motor (closed winding), with currents differing by 120° in phase, into a six-phase motor, with currents differing by 60° in phase.

the motor in Fig. 24 to be wound in the opposite direction; then an arrangement, symbolically indicated in Fig. 26, would be obtained, where the six halves of the former three coils, I, II, III, are now called I, I_2, II_2, II, III, and III_2, as we go round the triangle, Fig. 26. If now, without separating any of the connections, the coils I_2 and II be made to change places, as well as II_2 and III, we obtain the arrangement of winding shown on the motor in Fig. 27.

Now it is to be observed that since the coils I and I_2 (Fig 27) are in series, being in fact simply parts of the same coil I of Fig. 26, the current in the one must be, of course, exactly the same as the current in the other; but as one-half of the coil is wrapped one way round the iron ring, and the other half the other way, the currents, as far as sending a north pole round the ring is concerned, will have diametrically opposite effects—that is, will differ by 180° in phase. Hence, while the currents in the three coils I, II, III, in Fig. 24, differed by 120° in phase, the currents in the six coils I, II, III, I_2, II_2, III_2 (Fig. 27) will differ by 60° in phase, so that, as far as the magnetization of the iron ring is concerned, we have arrived at exactly the arrangement of currents shown in Fig. 18. There is, however, this important difference—that, whereas in Fig. 18 six main wires were required, in Fig. 27 only three are needed.

The difference in phase between the currents in the six coils (Fig. 27) and the currents in the mains can be at once obtained from Fig. 25. For it is easy to show that the current

$$\text{in} \quad \mathrm{I} = \frac{A+B}{3},$$
$$\text{,,} \quad \mathrm{II} = \frac{B-C}{3},$$
$$\text{,,} \quad \mathrm{III} = \frac{C+A}{3},$$

where A, B, and C represent simply the arithmetical values of the currents in the three main leads. Arithmetically, then, for the same currents in the mains A, B, C, the currents in the three coils I, II, III of Fig. 27 are the same as the currents in the three coils I, II, III of Fig. 24. But while, as far as sending north polarity counter-clockwise round the iron ring is concerned, the current in coil II of Fig. 24 was negative, that in coil II of Fig. 27 is positive. Hence, while it was the projection of O2 (Fig. 25) that gave the current in coil II of Fig. 24, it will be the projection of O2′ that will completely represent the current in coil II of Fig. 27, &c.

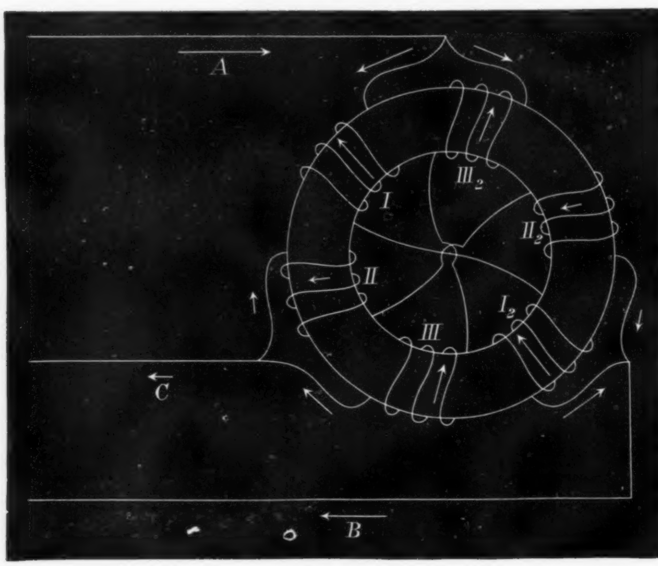


FIG. 27.—Six-phase alternate current motor (closed winding); currents differing by 60° in phase, and represented in direction and magnitude by the direction and length of the arrows.

Hence, in Fig. 27 the current in the coil I will be O I, the projection of O1; the current in the coil II will be O II′, the projection of O2′; that in coil III will be O III, the projection of O3; that in coil I_2 will be O I_2', the projection of

Or′, &c. And the various arrows attached to the various parts of Fig. 27 are all drawn so as to represent, in direction and by their proportional lengths, the currents as determined from Fig. 25.

If, instead of starting with the closed circuit three-phase motor (Fig. 24), we deal in the same sort of way

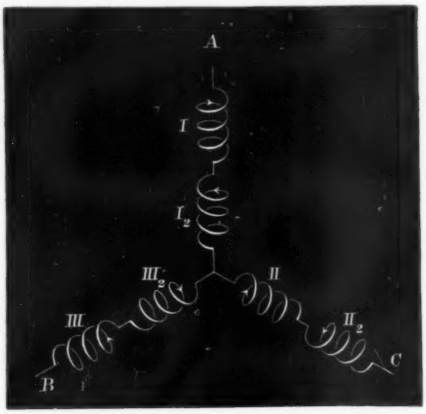


FIG. 28.—Transformation of a three-phase alternate current motor (open winding), with currents differing by 120° in phase, into a six-phase motor, with currents differing by 60° in phase.

with the open circuit three-phase motor (Fig. 20), we obtain Fig. 28, by supposing each coil to consist of two coils in series oppositely wound; and then, by interchanging the positions of the coils without breaking any of the connections, we arrive at the six-phase motor seen

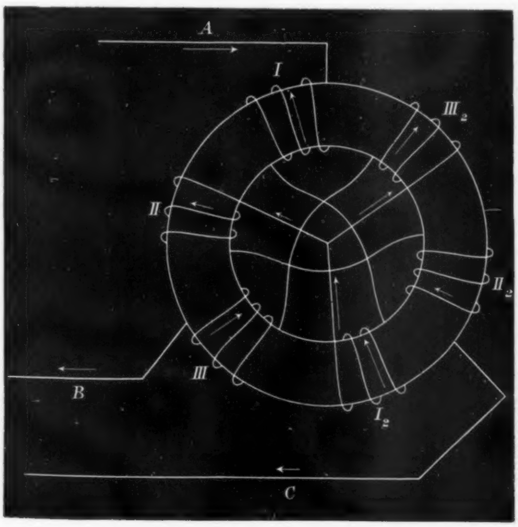


FIG. 29.—Six-phase alternate current motor (open winding); currents differing by 60° in phase, and represented in direction and magnitude by the direction and length of the arrows.

in Fig. 29, where the current in coil I is completely represented by Oa (Fig. 25), that in coil II by the projection of Oγ *produced backwards*, that in coil III by the projection of Oβ, &c.

Lastly, if we combine the closed and open methods of winding, and consider each coil as consisting of two in series but wound in opposite directions, we arrive at the symbolical Fig. 30; then, by interchanging the positions of the coils without separating any of the connections, the twelve-phase motor shown in Fig. 31 is produced,

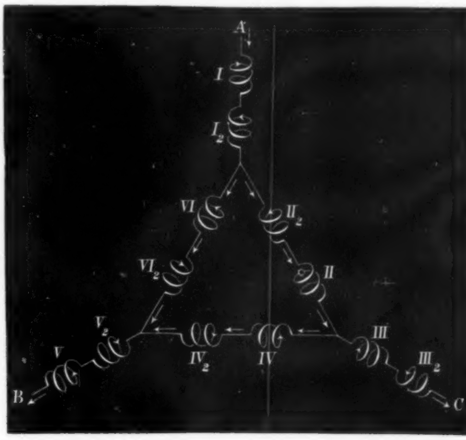


FIG. 30.—Transformation of an open wound combined with a closed wound six-phase alternate current motor into a twelve-phase motor with current differing by 30° in phase.

where the current in each coil differs from that in the preceding by 30° in phase.

In the twelve-phase motor (Fig. 31) the current in coil I is completely represented by the projection of Oa (Fig.

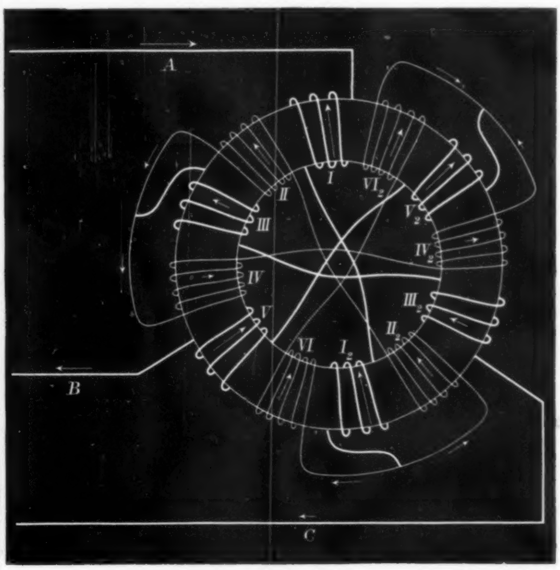


FIG. 31.—Twelve-phase alternate current motor; currents differing by 30° in phase and represented in direction and magnitude by the direction and length of the arrows.

25), that in coil II by the projection of O3′, that in coil III by the projection of Oγ *produced backwards*, that in coil IV by the projection of O2, &c. The maximum currents then in the coils II, II_2, IV, IV_2, VI, VI_2, will

be only $\frac{1}{\sqrt{3}}$, or 0·5744 times the maximum value of the currents in I, I_2, III, III_2, V, V_2. Hence the number of convolutions in each of the coils II, II_2, IV, IV_2, VI, VI_2 should be $\frac{5}{3}$rds of the number in each of the coils I, I_2, III, III_2, V, V_2, and the cross-section of the wire in each of the first six coils only $\frac{3}{5}$ths of that in the last six, both of which ratios are symbolically indicated in Fig. 31.

By still further following out the same general idea, an alternate current motor with twenty-four, or more, coils on it can be developed, requiring only three main wires to supply the current. And thus, thanks to the labours of Tesla, Bradley, Haselwander, Wenström, and last, but by no means least, to the striking ingenuity of Dolivo Doblowolsky, a practical alternate current motor can now be constructed, which will produce as steady a driving force as the best modern direct current motor.

W. E. A.

(To be continued.)

THE IMPLICATIONS OF SCIENCE.[1]

I.

WHEN I was honoured by an invitation to lecture here this evening, I felt much troubled as to the subject which I might most fitly select as my theme. During the forty years I have been a member of the Royal Institution, I have had the privilege of listening to lectures on many very different branches of science, and I know that all branches of science have few or many followers amongst the audience I am now addressing.

It has struck me, however, that for this single lecture it might be well not to confine myself to any subordinate department of scientific inquiry, but rather to invite your attention to certain questions which deeply concern them all. Thus, it has seemed to me, I might hope to interest a greater number of hearers than it would be possible for me otherwise to do.

I felt the more encouraged to take this course when I recalled to mind on how many previous occasions I had myself listened to discourses of a similar breadth of scope, given in this theatre by very distinguished men of science.

Foremost among them I may mention Prof. Huxley, who has here, as elsewhere, called attention to questions which underlie all physical science. I may also refer to that brilliant mathematician, Prof. Clifford, the sad and sudden ending of whose brief career we have good reason to deplore.

It would be easy to mention the names of other scientific celebrities who have here discoursed on matters beyond the scope of any one branch of science. These two, however, will, I think, suffice.

But before proceeding further I would feign say a few words as to the title of my lecture, so as at once to prevent any misunderstanding as to the object I have in view.

By "*the implications of science*," I mean nothing to which any section of my hearers can object, whatever their notions about "creed" or "conduct" may be. I desire carefully to eliminate all questions of either religion or morals, and I shall confine myself purely and simply to the consideration of certain propositions which appear to me to be latent within, and give force to, what we regard as well-ascertained scientific truths. They are propositions which must, I believe, be assented to by every consistent follower of science, who is convinced that science has brought to our knowledge *some* truths on which we can, with entire confidence, rely.

My appeal, then, is to the pure intellect of my hearers, and to nothing else. And indeed I desire to take this opportunity plainly to declare, before this distinguished audience, that not only here and now, but everywhere and always, I unhesitatingly affirm that no system can, or should, stand, which is unable to justify itself to reason. I possess no faculty myself, nor do I believe that any human faculty exists, superior to the intellect, or which has any claim to limit or dominate the intellect's activity. Feelings and sentiments have their undoubted charm and due place in human life, but that place is a subordinate one, and should be under the control of right reason.

But it is by no means only or mainly against those who would undervalue *reason* in the interest of *sentiment*, that I have this evening to protest. My object is to uphold what I believe to be the just claims of our rational nature against all who, from whatever side, or in the name of whatsoever authority, would impugn its sovereign claims upon our reverence, or unduly restrict the area of its sway.

As I have already intimated, I propose to fulfil this task by calling attention to some half-dozen far-reaching truths implicitly contained in scientific doctrines universally admitted, so that those doctrines cannot logically be maintained, if such implied truths are *really* and *seriously* doubted, and still less if they are *really* disbelieved and denied. These truths, then, are what I mean by "*the implications of science*." But what *is* science?

The word "science" is now very commonly taken as being synonymous with "*physical science*." There is much to be said against giving the word so narrow a meaning; nevertheless that meaning will sufficiently serve my purpose this evening. "Science," then, thus understood, is merely ordinary knowledge pursued with extreme care—most careful observation, measuring, weighing, &c.—together with most careful reasoning as to the results of observations and experiments, and also painstaking verification of any anticipations which may have been hazarded. In this way our thoughts are made to conform as accurately as may be with what we regard as the realities they represent.

The value and the progress of science are unquestioned. Many foolish discussions are carried on in the world about us; but certainly no one disputes or doubts the value of science or the fact of its progress. The value of carefully ascertained scientific truths will not at any rate be disputed in *this* theatre, which has witnessed the triumphs of the immortal Faraday, and which may justly claim to be a very temple of science. And certainly *I* have no disposition to undervalue it, who have loved it from my earliest years, and devoted such small powers as I possess to its service. I am profoundly convinced that, since I can recollect, biological science has made great progress, and I see grounds for absolute certainty now about many propositions in zoology which were doubtful or undreamed of when I was a lad.

We all, then, agree that science does advance. Nevertheless, it is obvious that such advance would be impossible if we could not, by observations, experiments, and inferences, become so certain with respect to *some* facts as to be able to make them the starting-points for fresh observations and inferences as to other facts. Thus, with respect to the world we live in, most educated men are now certain as to its daily and annual revolutions, as also that its crust is largely composed of sedimentary rocks, containing remains or indications of animals and plants more or less different from those which now live. No one can reasonably deny that we may rely with absolute confidence and entire certainty upon a variety of such assertions.

But our scientific certainties have been acquired more or less laboriously, and a questioning attitude of mind is emphatically the scientific attitude. We ought never to

[1] Friday Evening Discourse delivered at the Royal Institution by Dr. St. George Mivart, on June 5, 1891.

rest satisfied about any scientific inquiry the truth of which has not been demonstrated, unless we find that it is one which we have no possible power to answer. It would obviously be idle to occupy ourselves about the shape or number of the mountains on that side of the moon which is constantly turned away from us.

Yet, although doubt and inquiry are necessary in science, nevertheless doubt has its legitimate limits. Blind disbelief is scientifically fatal, as well as blind belief. We all know how apt men are, when seeking to avoid one extreme, to fall into the opposite one, and it is possible to get into an unhealthy condition of mind so as to be unable to give a vigorous assent to anything. It is necessary distinctly to recognize there is such a thing as *legitimate* certainty, not to perceive the force of which is *illegitimate* doubt. Such doubt would necessarily discredit all physical science.

Universal doubt, for example, is an absurdity. It is scepticism run mad.

If anyone affirms that "*nothing is certain*," he obviously contradicts himself, since he thereby affirms the certainty of uncertainty. He says *that*, which, if true, absolutely contradicts what he has declared to be true.

But a man who affirms what the system he professes to adopt forbids him to affirm, and who declares that he believes what he also declares to be unbelievable, should hardly complain if he is called "foolish." No system can be true, and no reasoning can be valid, which inevitably ends in absurdity. *Such* scepticism, then, cannot be the mark of an exceptionally intellectual mind, but of an exceptionally foolish one, and every position which *necessarily* leads to scepticism of this sort must be an untenable position.

A very little reflection suffices to show how self-refuting such modes of thought are.

Thus, if a man were to say, "*I cannot know anything because I cannot be sure that my faculties are not always fallacious*," or "*I cannot be sure of anything because, for all I know, I may be the plaything of a demon who amuses himself by constantly deceiving me*"—in both these cases he contradicts himself, because he obviously grounds his assertion upon his perception of the truth that "*we cannot arrive at conclusions which are certain by means of premisses which are uncertain or false.*"

But if he knows *that* truth, he must know that his faculties are not always fallacious, and that his demon cannot deceive him in everything.

My object in making these remarks is to enable us to get clear of mere idle, irrational doubts which have no place in science and can have none, so that we may recognize the fact that we all of us have certainty as to *some* facts according to our degrees of knowledge. Obviously we can only judge of truth by our mental faculties, and if a man denies their validity we must pass him by, contenting ourselves with calling his attention to the fact that he refutes himself. If a man professes to doubt his faculties, or to doubt whether language can be trusted to convey thought, then plainly we cannot profitably argue with him. But if, on account of his absurdity, we cannot refute him, it is no less plain that he cannot defend his scepticism. Were he to attempt to do so, then he would show, by that very attempt, that he really had confidence in reason and in language, however he might verbally deny it.

Confident, then, that there are some scientific statements on which we may rely with *certainty*, let us consider a few truths implicitly contained in them.

In the first place, science makes use not only of observations and experiments, but also of reasoning as to the results of such experiments. It needs that we should draw valid inferences; but this implies that we may, and *must*, place confidence in the principle of deduction—in that perception of the mind which we express by the word "*therefore*." When we use that word, we mean to express by it that there is a truth, the certainty of which is shown through the help of different facts or principles which themselves are known to be true.

It is sometimes objected to deductive reasoning—to the syllogism—that it really teaches us nothing new, all that is contained in the conclusion being contained already in the premisses. But this objection is due to a want of perception of the great difference which exists between *implicit* and *explicit* knowledge. Let us suppose a person to be looking at some very flexible and soft kind of fish. He may, perhaps, say to himself, "This creature can have no spinal column!" Then it may strike him that naturalists have classed fishes, together with other animals, in a great group, one character of which is the possession of a spinal column, and so he may *explicitly* recognize a truth implied in what he knew before. So great, indeed, is the difference between explicit and implicit knowledge, that the latter may not really deserve to be called "*real knowledge*" at all. No one will affirm that a student who has merely learned the axioms and definitions of Euclid has attained such a *real knowledge* of all the geometrical truths the work contains that he will fully understand all its propositions and theorems without having to study them. Yet all the propositions, &c., of Euclid are *implicitly* contained in the definitions and axioms. Nevertheless, the student will have to go through many processes of inference by which these implicit truths may be explicitly recognized by him, before he can be said to have any real *knowledge* of them.

The VALIDITY OF INFERENCE is, then, one of the truths implied by physical science, and we shall presently see the intellectual penalty which must be paid for any *real* doubt about it.

In the second place, physical science is emphatically experimental science. But every experiment, carefully performed, implies a most important latent truth. For when an experiment has shown us that anything is certain—as, for example, that a newt's leg may grow again, after amputation, because one actually *has* grown again; we shall find that such certainty implies a prior truth. It implies the truth that if the newt has come to have four legs once more, it cannot at the very same time have only three legs. This may seem too trivial a remark to some of my hearers, but there is nothing like a *concrete* example for making an *abstract* truth plain. Anything we are certain about, because it has been proved to us by experiment, is certain only if we know, and because we know, that a thing which has been actually proved cannot at the same time remain unproven. If we reflect again on this proposition, we shall see that it depends on a still more fundamental truth which our reason recognizes—the truth, namely, that "nothing can at the same time both be and not be"—the truth known as "THE LAW OF CONTRADICTION"; and this I bring forward as a second truth implied by physical science.

If we reflect upon this law, we shall see that our intellect recognizes it as an absolute and necessary truth which carries with it its own evidence. It is but the summing up in one general expression, of all the concrete separate cases—such as that of the newt's legs, of the fact that if a man possesses two eyes he cannot at the same time have only one, and so on.

But an objection has been made as follows: "It is very true that I cannot imagine having 'two eyes' and only 'one eye' at the same time, and so I must practically acquiesce in the statement, but I am only compelled to do so by the impotence of my imagination." Thus, instead of the "law of contradiction," Mr. Herbert Spencer has put forward as an ultimate truth—"his universal postulate"—the assertion that "*we must accept as true propositions we cannot help thinking, because we cannot imagine the contrary.*" But if any of my hearers will reflect over what his mind tells him when it pronounces

that he cannot at the same time have both two eyes and only one eye, he will, I think, see that his perception is (as *mine* is) a perception of real incompatibility, and consequent positive impossibility. He will not find his mind a mere blank, passively unable to imagine something. He will find that his mind actively asserts its power to judge of the matter as well as what its judgment is, and that the truth is one which positively applies to *things*, and not merely to his own imaginings.

Moreover, this objection ignores the difference between intellect and imagination. Yet there are very many things we can conceive of but cannot imagine, as, for example, our "act of sight" or "our own annihilation."

But it appears to me evident that Mr. Herbert Spencer's "universal postulate" can never be itself an ultimate truth, but must depend upon the law of contradiction. For, supposing we had tried to imagine a thing and *failed*, how could we from that ever be sure we might not at the same time have actually tried and *succeeded*, if we could not rely upon the law of contradiction?

The consequences resulting from any real doubt as to this law we will see later on.

In the pursuit of science, observation is anterior to experiment; but in every observation in which we place confidence, and still more in every experiment, a third fundamental truth is necessarily implied: this implied truth is THE VALIDITY OF OUR FACULTY OF MEMORY.

It is plain that it would be impossible for us to be certain about any careful observation or any experiment, if we could not feel confidence in our memory being able to vouch for the fact that we had observed certain phenomena and what they were. But what is memory?

Evidently we cannot be said to remember anything unless we are conscious that the thing we so remember has been present to our mind on some previous occasion. A mental image might present itself to our imagination a hundred times; but if at each recurrence it seemed to us something altogether new, and unconnected with the past, we could not be said to *remember* it. It would rather be an example of extreme forgetfulness than of memory.

By asserting the trustworthiness of our faculty of memory, I do not, of course, mean that we may not occasionally make mistakes about the past. It is quite certain we may, and do, make such mistakes. But, nevertheless, we are all of us certain as to *some* past events. Probably there is no single person now in this room who is not certain that he was somewhere else before he entered it. Memory informs us—certainly it informs *me*—as surely concerning *some* portions of the past, as consciousness does concerning some portions of the present.

If we could not trust our faculty of memory, the whole of physical science would be, for us, a mere present dream. But there can be no such thing as *proof* of the trustworthiness of memory, since no argument is possible without trusting to the veracity of memory. It is therefore a fundamental fact which must be taken on its own evidence, and from a consideration of the results of any real doubt about it—results I will refer to presently.

Yet it has been strangely declared, by a leading agnostic, that we may trust our memory because we learn its trustworthiness by experience. Surely never was fallacy more obvious! How could we ever gain experience if we did not trust memory in gaining it? Particular acts of memory may, of course, be confirmed by experience if the *faculty* of memory be already trusted, but in every such instance it must be confided in. The agnostic referred to has told us in effect that we may place confidence in our present memory because in past instances its truth has been experimentally confirmed, while we can only know it *has* been so confirmed by trusting our present memory!

But if we admit the trustworthiness of memory at all, a most important consequence follows—one relating to the distinction between what is *subjective* and what is *objective*.

Every feeling or state of consciousness present to the mind of the subject who possesses it is "subjective," and the whole of such experiences taken together constitute the sphere of *subjectivity*. Whatever is external to our present consciousness or feelings is for us "objective," and all that is thus external is the region of OBJECTIVITY. Now memory, inasmuch as it reveals to us part of our own past, reveals to us what is "objective," and so introduces us into the realm of objectivity, shows us more or less of objective truth, and carries us into a real world which is beyond the range of our own present feelings. This progress, then, this knowledge of *objectivity*, is, through memory, IMPLIED in every scientific experiment the facts of which we regard as certain.

But our scientific observations and experiments carry with them yet another implication more important still: this is the certainty of our KNOWLEDGE OF OUR OWN CONTINUOUS EXISTENCE. Unless we can be sure that we actually made the observations and experiments, on our having made which we rely for our conclusions, how can those conclusions be confidently relied on by us?

This implication is so important—in my opinion so *fundamentally* important—that I must crave your permission to notice it, later on, at some length. But before considering it, I desire to call your attention to the fact that the propositions thus implied by physical science, run directly counter to a system of thought which is widely current to-day, and which has now and again found expression in this theatre. The popular views I refer to may be conveniently summed up as follows:—

(1) All our knowledge is merely relative.

(2) We can know nothing but phenomena.

(3) We have no supremely certain knowledge but that of our own feelings, and therefore we have none such of our continuous existence.

(4) We cannot emerge from subjectivity, or attain to real knowledge of anything objective.

Therefore, either I am very much mistaken, or those who uphold the views I have just summed up are much mistaken.

It may seem presumptuous on my part to come forward here to-night to controvert a system upheld by men of such undoubted ability and so unquestionably competent in science, as are men who uphold the system I oppose. I feel therefore that a few words of personal apology and explanation are due from me.

For full five-and-thirty years I have been greatly interested in such questions. But when my intellectual life began, it was as a student and disciple of that school with which the names of John Stuart Mill, Alexander Bain, G. H. Lewes, Herbert Spencer, and Prof. Huxley have been successively associated—more or less closely. The works of writers of that school I studied to the best of my ability, and I had the advantage of personal acquaintance with some of the more distinguished of them. Thus, by conversation, I was much better enabled to learn what their system was than I could have learned it by reading only.

However, by degrees, I became sceptical about the validity of the system I had at first ingenuously adopted, but it took me not a few years to clearly see my way through all the philosophical fallacies—as I now regard them—in which I found myself entangled. I say "see my way *through*," for I did not free myself from them by *drawing back* but by *pushing forwards*—slowly working my way through them and out on the other side. These circumstances constitute my apology for appearing before you as I do. I have been a dweller in the country which I am willing to aid anyone to explore who may wish to explore it.

(*To be continued.*)

ELECTRICITY IN RELATION TO SCIENCE.

THE third annual dinner of the Institution of Electrical Engineers was held at the Criterion on Friday, November 13. Prof. William Crookes, the President, was in the chair. In proposing the toast of the evening, "Electricity in relation to Science," Prof. Crookes delivered the following speech:—

We have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg quivering on Galvani's work-table and the successful telegraph or telephone there exists a direct filiation. Without the one we could not have the other.

We know little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Prof. Lodge considers it "a form, or rather a mode of manifestation, of the ether." Prof. Nikola Tesla demurs to the view of Prof. Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if, like life or like matter, it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions.

The light which the study of electricity throws upon a variety of chemical phenomena—witnessed alike in our little laboratories and in the vast laboratories of the earth and the sun—cannot be overlooked. The old electro-chemical theory of Berzelius is superseded, and a new and wider theory is opening out. The facts of electrolysis are by no means either completely detected or co-ordinated. They point to the great probability that electricity is atomic, that an electrical atom is as definite a quantity as a chemical atom. The electrical attraction between two chemical atoms being a trillion times greater than gravitational attraction is probably the force with which chemistry is most deeply concerned.

It has been computed that, in a single cubic foot of the ether which fills all space, there are locked up 10,000 foot-tons of energy which have hitherto escaped notice. To unlock this boundless store and subdue it to the service of man is a task which awaits the electrician of the future. The latest researches give well-founded hopes that this vast storehouse of power is not hopelessly inaccessible. Up to the present time we have been acquainted with only a very narrow range of ethereal vibrations, from extreme red on the one side to ultra-violet on the other—say from 3 ten-millionths of a millimetre to 8 ten-millionths of a millimetre. Within this comparatively limited range of ethereal vibrations, and the equally narrow range of sound vibrations, we have been hitherto limited to receive and communicate all the knowledge which we share with other rational beings. Whether vibrations of the ether, slower than those which affect us as light, may not be constantly at work around us, we have until lately never seriously inquired. But the researches of Lodge in England, and Hertz in Germany, give us an almost infinite range of ethereal vibrations or electrical rays, from wave-lengths of thousands of miles down to a few feet. Here is unfolded to us a new and astonishing universe—one which it is hard to conceive should be powerless to transmit and impart intelligence.

Experimentalists are reducing the wave-lengths of the electrical rays. With every diminution in size of the apparatus the wave-lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar; yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths, when excited by a high-tension current in a high vacuum, is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat rays. Of such production of light, Nature supplies us with examples in the glow-worm and the fire-flies. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments.

By means of currents alternating with very high frequency, Prof. Nikola Tesla has succeeded in passing by induction through the glass of a lamp energy sufficient to keep a filament in a state of incandescence without the use of connecting wires. He has even lighted a room by producing in it such a condition that an illuminating appliance may be placed anywhere and lighted without being electrically connected with anything. He has produced the required condition by creating in the room a powerful electrostatic field alternating very rapidly. He suspends two sheets of metal, each connected with one of the terminals of the coil. If an exhausted tube is carried anywhere between these sheets, or placed anywhere, it remains always luminous.

The extent to which this method of illumination may be practically available experiments alone can decide. In any case, our insight into the possibilities of static electricity has been extended, and the ordinary electric machine will cease to be regarded as a mere toy.

Alternating currents have at the best a rather doubtful reputation. But it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous but less so. It further appears that a true flame can now be produced without chemical aid—a flame which yields light and heat without the consumption of material and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether? If so, we may view the prospective exhaustion of our coal-fields with indifference; we shall at once solve the smoke question, and thus dissolve all possible coal-rings.

Electricity seems destined to annex the whole field not merely of optics, but probably also of thermotics.

Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave-length of which we have spoken will easily pierce such mediums, which for them will be transparent.

Another tempting field for research, scarcely yet attacked by pioneers, awaits exploration I allude to the mutual action of electricity and life. No sound man of science endorses the assertion that "electricity is life"; nor can we even venture to speak of life as one of the varieties or manifestations of energy. Nevertheless electricity has an important influence upon vital phenomena, and is in turn set in action by the living being—animal or vegetable. We have electric fishes—one of them the prototype of the torpedo of modern warfare. There is the electric slug which used to be met with in gardens and roads about Hornsey Rise; there is also an electric centipede. In the study of such facts and such relations the scientific electrician has before him an almost infinite field of inquiry.

The slower vibrations to which I have referred reveal

the bewildering possibility of telegraphy without wires, posts, cables, or any of our present costly appliances. It is vain to attempt to picture the marvels of the future. Progress, as Dean Swift observed, may be too fast for endurance. Sufficient for this generation are the wonders thereof.

GEOLOGICAL PHOTOGRAPHS.

AT the meeting of the British Association in 1889, a Committee was appointed for the purpose of arranging for the collection, preservation, and systematic registration of photographs of geological interest in the United Kingdom. Since its formation, the Committee has succeeded in obtaining a number of photographs, 588 of which were received and registered up to August last; and in its second report, presented at the Cardiff meeting of the British Association, the Committee was able to state that, in the choice of subjects, greater care had been taken during the year to include the most typical views. As yet, only about half of the British counties are represented in the collection, while some are still represented inadequately. The work is one of great interest and importance, both from a scientific and an educational point of view, and it may be hoped that local Societies and Field Clubs, whose co-operation the Committee is particularly anxious to secure, will everywhere associate themselves with the scheme, and do what they can to bring it to completion. The Committee, in a circular just issued, suggests that these Societies and Clubs might materially aid the scheme by mapping out their districts under the direction of a local geologist, and drawing up a list of sections and localities of which photographs would be desirable. New sections and exposures of strata should be noted. This preliminary work could be done during the winter session, and arrangements made for the use of the camera in the ensuing spring, or when opportunity offered.

In its report, the Committee refers especially to the work accomplished by the Geological Photographic Committee of the Yorkshire Naturalists' Union. Among the photographs of this Society are many relating to sections which cannot be reproduced—as, for instance, fossil trees laid bare in quarrying and in excavations for the foundations of buildings now covered over. The Hertfordshire Natural History Society and the East Kent Natural History Society have also organized schemes for the photography of local geological features; and the Committee has already received from them views which, it is hoped, will be supplemented by a further series next year.

Of course it is not always easy to obtain the services of a professional photographer, but few Societies should have much difficulty in securing the help of amateur photographers, so many of whom are now to be found in all parts of the country. In order that there may be unity of action, the Committee has drawn up a set of instructions, copies of which may be obtained on application to the secretary, Mr. Osmund W. Jeffs, 12 Queen's Road, Rock Ferry, Cheshire. It is pointed out that the photographs should illustrate characteristic rock exposures, especially those of a typical character or temporary nature; important boulders; localities affected by denudation, or where marked physiographical changes are in operation; raised beaches; old sea-cliffs and other conspicuous instances of marine erosion; characteristic river-valleys or escarpments, and the like; glacial phenomena, such as *roches moutonnées*, moraines, drums, and kames; or any natural views of geological interest. Photographs of microscopical sections and typical hand-specimens of rocks are also admissible.

Detailed lists of photographs officially received are published in the report of the Committee, which also states where the photographs may be obtained. Lists for insertion in the third report will be received up to June 15, 1892.

It is satisfactory to find that geological photographic schemes similar to that of the British Association are being adopted in other countries. The Committee, in its second report, alludes to the action taken in the matter by the Société Géologique de Belgique, and to the Committee of Photographs appointed by the Geographical Society of America. The American Committee proposes to prepare lists for international exchange.

NOTES.

AFTER a rather prolonged delay, the Commission for the delimitation of the Anglo-French frontier in the neighbourhood of Sierra Leone, in accordance with the West African agreement between Great Britain and France of August 10, 1889, has been appointed. Captain Kenney, R.E., the British Commissioner, with his party, proceeded to Sierra Leone by the steamer of November 14 last. The Secretary of State for the Colonies permitted the Director of Kew to nominate a botanist to accompany the expedition, and the Government Grant Committee of the Royal Society made a grant to meet his expenses, part of which will also be borne by the Government of Sierra Leone. The mission has been undertaken by Mr. G. F. Scott-Elliot, M.A. Camb., B.Sc. Edinb., F.L.S., who has recently published in the Journal of the Linnean Society an account of the new species of plants found by him in a journey through a little known part of Southern Madagascar. The botany of the interior of Sierra Leone is very little known, but is believed to be of great interest. The Commission will be absent about six months. It will proceed in the first instance to Falaba, and then proceed to the point of intersection of the 10th parallel of North latitude and the 13th meridian (French) of West longitude.

WE understand that Prof. Hennessy, F.R.S., will shortly resign the Chair of Applied Mathematics and Mechanism in the Royal College of Science, Dublin. The salary of the post is £400, rising to £500, a year, with a share of the fees. The appointment rests with the Lord President of the Council, and applicants should address themselves to the Secretary, Science and Art Department.

THE arrangements to be made for the Crystal Palace Electrical Exhibition are to be discussed at a meeting of the honorary council of advice and of the special committee appointed by the Electrical Section of the London Chamber of Commerce. The meeting will be held at the Mansion House on Wednesday, November 25, at 3 o'clock. The Lord Mayor will preside. The whole of the space is now practically allotted, extra buildings having been erected for certain large installations which could not otherwise have been accommodated.

A COMMITTEE has been appointed by the American Institute of Electrical Engineers to suggest plans for the International Electrical Congress to be held in Chicago in 1893, in connection with the World's Fair. A local Committee, with Prof. Gray as President, is being formed at Chicago for the purpose of making preparations for the same Congress. The Chicago journal *Electricity* sees no reason "why a perfectly harmonious arrangement should not be made between the Institute and the local Committee, whereby both will work together to promote the success of the Congress."

THE Spanish Government intend to open two Exhibitions in September 1892 in celebration of the fourth centenary of the discovery of America. One of these will be at Madrid, and will be called the Exposition Historique Américaine de Madrid. The

other, at Huelva, will be called the Exposition Historique Européenne de Madrid. The former should have considerable interest for anthropologists, as it has for its object, according to the official programme, "de présenter de la manière la plus complète l'état où se trouvaient les différentes contrées du Nouveau-Continent avant l'arrivée des Européens et au moment de la conquête, jusqu'à la première moitié du XVII^e siècle." It will comprise objects, models, pictures, &c., illustrating the customs and civilization of the peoples at that time inhabiting America.

WE greatly regret to have to record the death of Prof. Henry N. Moseley, F.R.S. He died on November 10, at the age of forty-six. We hope next week to give some account of his services to science.

DR. OSCAR BAUMANN is about to undertake a series of explorations in the interest of the German East Africa Company. In the German Masai territory there are, he says, in a letter to *Globus*, many regions about which little is known; and about these he hopes to bring back much fresh light. He proposes to study the conditions which must be taken into account by projectors of railways, and, if possible, to open a direct caravan route to Lake Victoria.

IN the course of his interesting presidential address at the meeting of the Institution of Civil Engineers last week, Mr. Berkley referred to the production of iron in the United States. The most conspicuous difference between American and English practice, he said, was the output from one blast furnace. The largest production in Great Britain did not seem to exceed 750 tons in the week, while in America it had reached 2000 tons. It might be questioned whether this large output from a single furnace was not obtained at some sacrifice of economy of fuel used and of wear and tear of furnace. The production of pig-iron in the United States now amounted to 10,000,000 tons, or 2,000,000 tons more than that of the United Kingdom. This amount was wholly used within the country, showing a larger quantity of iron used per head of the population (300 pounds) than in any other part of the world. In Great Britain, after deducting from its production of iron the quantity exported, the consumption only equalled 250 pounds per head of the population.

THE lecture season at the London Institution, Finsbury Circus, was opened on Monday evening with a lecture by Sir M. E. Grant Duff on "Some of our Debts to the East."

THE barometric depression on November 11, according to Mr. G. J. Symons, has been exceeded only five times in the 34 years during which he has been making meteorological observations. In a letter to the *Times* Mr. Symons says that as he anticipated some such depression, he started the Richard brontometer at 6.30 a.m., and kept it running for 10 hours—*i.e.* through the chief part of the depression. This, at the cost of a little trouble and a roll of paper, gave him a record of the motion of the barometer such as had never before been obtained —somewhere about 60 feet long—and with every little pulsation shown in detail, even if it lasted only two seconds.

WE have received the meteorological year-book published by the Madgeburg *Zeitung* for 1890, being the tenth year for which the observations have been made on a uniform plan. In addition to observations taken three times daily, the volume contains hourly values of pressure and wind, and continuous records of sunshine; also, curves of pressure and temperature for those periods of exceptional weather during which the ordinary hourly values would fail to represent the details of the oscillations—a plan which seems highly commendable. The whole work is very complete and compact.

THE Deutsche Seewarte has published a catalogue of its valuable library, containing entries of 10,660 works and excerpt papers in various subjects, about a quarter of which refer to meteorology. The library has been enriched by the acquisition of the books which formerly belonged to Prof. Dove and other eminent men. This laborious undertaking has been carried out with great care, and is classified under subjects and authors. Some difficulty has been experienced in dealing with a few English authors; *e.g.*, on p. 67, Balfour Stewart is entered under the Christian name, and on p. 160, Powell is entered as the Christian name of Baden-Powell. And the works issued by institutions are not always sufficiently distinguished from those which are due to individual writers; *e.g.*, on p. 5, Sir Thomas Farrer is credited with a work on "Telegraphic Weather Information"—of which, probably, he would have no recollection, it being merely a circular signed in his capacity as Secretary of the Board of Trade. But these are mere trifles, and in no way detract from the value of the work as a whole, for which the scientific world will be grateful.

MR. ALBERT KOEBELE, the American entomologist, is travelling in the Australasian colonies for the purpose of studying the enemies of insect pests. In introducing him to the Wellington Philosophical Society at a meeting on September 23, Sir James Hector recalled the circumstances connected with a memorable service which Mr. Koebele lately rendered to California. In 1888, when on a visit to South Australia in search of a small fly (Testophonus), a parasite on that dreadful pest *Icerya purchasi*, Mr. Koebele discovered a single ladybird (Vedalia) preying on the pest. He found a second specimen in New South Wales, and then on his arrival in New Zealand he found that the Icerya about Auckland was also being destroyed by something, and this, too, turned out to be Vedalia. He at once saw that here was the thing he sought, and he was fortunate enough to be able to collect several thousands of Vedalias, which he afterwards liberated in California. Up to that time California had been so eaten up by Icerya that the damage was estimated at twenty millions of dollars annually. Yet, in twelve or fifteen months after the liberation of Vedalia in April 1889, the State was practically free from the dreaded pest. Sir James Hector rightly characterized this work of Mr. Koebele as one of the grandest things in the interest of fruit and tree-growers that have been effected in modern times.

PROF. G. L. GOODALE, of Harvard University, has recently paid a visit to the Museums and Botanical Gardens in the tropics and in the southern hemisphere, and has contributed an interesting description of them to the *American Journal of Science*. In the number for October we find an account of the Technological Museum at Sydney, which contains a very complete collection of the economic vegetable products of Australia, and which is largely visited by the working classes; of the two Botanic Gardens at Brisbane, one of them under the management of the Society of Acclimatization; the Botanic Gardens at Geelong, Dunedin, Christchurch, and Wellington; the Museums at Dunedin, Christchurch, Wellington, and Auckland; and the small but excellent local Museum and Garden at Hobart. Prof. Goodale notices, with commendation, the tenacity with which all the Australian Museums cling to rare specimens of archæological and ethnographical interest, instead of utilizing them for exchange.

MESSRS. MACMILLAN AND CO. have published the first number of the *Record of Technical and Secondary Education*, a bi-monthly journal of the progress made by County Councils and other local authorities in the administration of the Technical Instruction Acts. The periodical is issued on behalf of the National Association for the Promotion of Technical and Secondary Education. Lord Hartington contributes an intro-

ductory statement, in which he sets forth briefly the objects of the *Record*. It will, he says, be of a strictly practical character, and will not interfere with any educational journal now in circulation. It will "give the latest information, not only with respect to what is being done in this Kingdom, but also in regard to such educational work on the Continent and in America as may be of service to those who are engaged in carrying out schemes of technical instruction." The *Record* may become a journal of great value, and we trust there will be a cordial response to Lord Hartington's appeal to the members of the County Councils, their organizing secretaries, and others interested in the work, to supply the Committee with early and regular information as to what is being done in their several centres. The present number contains, besides Lord Hartington's statement, County Council schemes and reports relating to Oxfordshire, Surrey, Bedfordshire, Lancashire, Birmingham, and Aberdeen; details regarding Scholarship schemes in the West Riding and Somerset; notes on the work of the counties and county boroughs; miscellanea; and reviews.

THERE are not many remains of the ancient Mexican featherwork which excited the surprise of the Spanish conquerors of the New World. The most famous surviving specimen is the standard, described by Hochstetter, which is now in the Vienna Ethnographical Museum. Another specimen has lately been discovered by Mrs. Zelia Nuttall in the Schloss Ambras, near Innsbruck. It is mentioned in an inventory, drawn up in 1596, of the treasures of the castle. This very valuable relic is the decorative part of a round shield made of interlaced reeds, and consists of feather-mosaics representing a monster, the contours of which are fastened by strips of gold. Formerly the shield was adorned with costly quetzal feathers, only small fragments of which survive. *Globus*, which has an interesting note on the subject, speaks of similar old Mexican shields in the Stuttgar Museum, and refers to a statement of Stoll to the effect that beautiful feather-ornaments are still made by the Indians of Guatemala.

IN the Report of the U.S. National Museum for 1884, Prof. O. T. Mason published a short paper on the throwing-sticks of the Eskimo. The use of a like device for the throwing of spears and harpoons was formerly well known in Mexico; and Prof. Mason has written to *Science* to say that he lately received from Lake Patzcuaro, in Mexico, "a modern altatl, well worn and old-looking, accompanied with a gig for killing ducks." The apparatus, which was bought from the hunter by Captain J. G Bourke, U.S.A., has been placed in the National Museum. The thrower is 2 feet 3 inches long, and has two finger-holes, projecting, one from the right, one from the left side. The gig consists of three iron barbs, exactly like the Eskimo trident for water-fowl. "The problem now is," says Prof. Mason, "to connect Alaska with Patzcuaro."

A PAMPHLET on "The Dwarfs of Mount Atlas," by Mr. R. G. Haliburton, has been published by Mr. David Nutt. Along with it are printed portions of the paper on the subject read by Mr. Haliburton before the recent Oriental Congress. His views are accepted by Sir J. Drummond-Hay, who represented Great Britain in Morocco for over forty years, and by Mr. Hunnot, our Consul at Saffi. There is, of course, no inherent improbability in the statement that there are tribes of dwarfs to the south of Mount Atlas. Such tribes are known to exist elsewhere in Africa, and they may exist in the regions where Mr. Haliburton thinks he has discovered them. The question is one of evidence. Even if dwarfs have many settlements there, it does not follow that there is any solid foundation for Mr. Haliburton's theories as to the part their race has played in the evolution of mythology. Still the suggestion is an interesting one.

IN the report on "Oysters and Oyster-Fisheries of Queensland," to which we referred last week, Mr. Saville-Kent presents quite an idyllic picture of the circumstances of those who devote themselves in Queensland to the culture of "bank oysters"—that is, oysters which spread over extensive level banks that are more or less uncovered at low water. He says that "probably in no other country in the world is so healthy, congenial, and unlaborious a means of earning a substantial competency open to, and turned to practical account by, all classes as that of bank oyster culture in the Queensland oyster-producing districts of Moreton or Wide Bays. With a nominal rental payable for the ground cultivated and occupied for a homestead, a climate that permits of dispensing with all but the most necessary form of raiment, and fish procurable in such abundance as to substantially minimize the butcher's bill, no more perfect terrestrial Elysium is probably at the disposal of small capitalists having sufficient means for the supply of their most immediate necessities during that first year or two that must elapse before their oyster-crops have increased to a remunerative extent."

MR. CHARLES CHILTON contributes to the new number of the *Records of the Australian Museum* (vol. i. No. 8) an excellent paper on a new and peculiar fresh-water "Isopod" from Mount Kosciusko. Towards the end of 1889, Mr. Chilton received from the trustees of the Australian Museum, Sydney, a small collection of Australian Crustacea, containing, among others, some terrestrial and fresh-water species collected by Mr. R. Helms while on an expedition to Mount Kosciusko on behalf of the Museum. Among these Mr. Chilton at once saw that one was quite different from any of the terrestrial and freshwater Crustacea previously described from Australia, and that it belonged to a genus *Phreatoicus* established by himself in 1882, for a peculiar blind subterranean Isopod found in wells in Canterbury, New Zealand. This genus was of special interest, both because of the situation in which the original species was found, and because it combined characters belonging to several different families, and was also, to some extent, intermediate between the Isopoda and the Amphipoda. The discovery of a species belonging to the same genus in such a widely remote situation as Mount Kosciusko, and living under such different conditions, was therefore of peculiar interest; and Mr. Chilton thinks that it will probably have an important bearing on the difficult question of the origin of the blind subterranean forms. In the paper in the *Records* he does not enter upon this question, but he hopes to do so on a future occasion, when describing more fully the subterranean forms from New Zealand.

MESSRS. MACMILLAN AND CO. have issued the fifth edition, revised, of Part IV. of Prof. M. Foster's "Text-book of Physiology." This completes the work, with the exception of the appendix, which differs so widely in character from the rest of the book that it seemed desirable to issue it separately. It will be published very shortly.

SOME time ago the Department of Agriculture in New South Wales included in its list of economic plants suitable for cultivation in the north-eastern portion of the colony the "Avocado" or "Alligator pear" (*Persea gratissima*, Gærtn.). Several inquiries about it having since been made, Mr. F. Turner provides an account of the plant, with an illustration, in the August number of the *Agricultural Gazette* of New South Wales. Unless it is grown in very sheltered situations, the climate of Sydney is too cold for its successful cultivation as a commercial crop; but Mr. Turner thinks that on the northern rivers of New South Wales it should bear fruit as prolifically as it does in Southern Queensland. Some years ago, in the Brisbane Botanic Gardens, a fine Alligator pear-tree bore annual crops of very fine fruit, and it may do so still. When Sir W. W. Cairns was Governor of Queensland, he often asked Mr. Turner for some of the fruit when it was in

season, and Mr. Turner kept him well supplied, for at that time no one seemed to care much for it. His Excellency told Mr. Turner he was very fond of the fruit for breakfast, and he used to eat it spread on bread and butter, with pepper and salt added to give it zest, and in various other ways. Mr. Turner did not care for the fruit at first, but afterwards became as fond of it as his tutor. So we are not unlikely to hear of the Alligator pear by-and-by as a popular Australian product.

MESSRS. J. B. BAILLIÈRE ET FILS, Paris, have lately added some good volumes to their well-known Bibliothèque des Connaissances Utiles. In one of them—"La Pêche et les Poissons des Eaux Douces"—M. Arnould Locard presents a clear and interesting summary of the various classes of facts which must be understood by all who desire to become expert in the art of fishing in fresh waters. M. Lacroix-Danliard contributes a volume on "La Plume des Oiseaux," dealing with the birds whose feathers are utilized by man, and with the industrial processes to which the demand for feathers has given rise. A useful volume on "Les Plantes d'Appartement et les Plantes de Fenêtres" is contributed by M. D. Bois.

UNDER the title "Bibliotheca Accipitraria," Mr. J. E. Harting has on the eve of publication a bibliography of falconry, with critical notes. It deals with 378 works in various languages, ancient and modern, and will be illustrated with portraits of famous falconers by Holbein, Titian, Vandyck, Frans Floris, Gerhardt, and other masters. The volume concludes with an English glossary, and a vocabulary, in seven languages, of the technical terms used by falconers.

AN important treatise on Salt-Range fossils has been issued in the series entitled "Palæontologia Indica," which contains figures and descriptions of the organic remains procured during the progress of the Geological Survey of India. Prof. Waagen, the author of the treatise, in concluding it says he has tried to make it as useful as possible both to Indian geology and to geological science in general.

MR. STUART A. RUSSELL's new work on electric light cables and the distribution of electricity will be issued shortly in Messrs. Whittaker's "Specialists' Series."

MESSRS. DULAU AND CO. have issued a catalogue of zoological and palæontological books which they offer for sale. It includes the following "parts"—Natural history publications of the British Museum; Protozoa, Bacteria; Cœlenterata.

THE last volume of the Memoirs of the Statistical Section of the Russian Geographical Society contains an interesting work by M. Borkovsky, who has devoted more than twenty-five years of his life to the study of the grain-production of Russia, and the directions in which cereals are transported within Russia both for export and for home consumption. The results totally upset the current theory as to Russia being a granary of Europe, and are grimly confirmed by the famine which now prevails in several provinces of the empire. It appears from M. Borkovsky's figures and maps that Russia may be divided into two parts, strictly dependent on her orographical structure: one of them, which corresponds to the south-eastern slope of the broad swelling which stretches across the country from south-west to north-east, has an excess of grain during the years of good crops, which excess sometimes exceeds twice or thrice the wants for local use. But there is also another part—the north-western one—which always has less corn than is wanted for its population. Taking the years 1882-85, which were years of average crops, a line traced from Kieff to Nijni-Novgorod and further north-east divides Russia into two almost equal parts, of which the south-eastern exports wheat and rye into the north-western part to the amount of no less than 710,000 tons of wheat and 508,000 tons of rye, the exports to foreign countries attaining at the same time the respective figures of 1,780,000 and 1,029,600 tons. Taking into account the respective populations of the two regions, and the amount of corn consumed by the distilleries (which does not exceed 14 English pounds per inhabitant), M. Borkovsky shows that the total consumption of wheat and rye attains only the figure of 437 pounds per inhabitant (109 pounds of wheat) in the exporting region, and the still lower figure of 382 pounds (46 pounds of wheat) in the region which imports corn. The average consumption throughout Russia thus attains only 430 pounds per inhabitant, out of which 14 pounds must be deducted for the use of the distilleries. These figures will certainly seem very low if it is remembered that the great mass of the Russian peasants consume extremely small quantities of meat—bread being their chief and almost exclusive food. It appears, moreover, that if Russia exported no grain at all, and the whole of the crop of cereals were consumed within the country, the average consumption would nearly approach the average consumption in France—that is, 505 English pounds on an average year; while the surplus obtained during years of exceptionally good crops would only cover the deficit during the bad years, which recur in the steppes of South-East Russia with almost the same regularity as in India, *i.e.* every ten to twelve years.

AN important paper is contributed by M. Moissan to the current number of the *Comptes rendus* describing two interesting new compounds containing boron, phosphorus, and iodine. A few months ago M. Moissan succeeded in preparing the iodide of boron (comp. NATURE, vol. xliii. p. 565), a beautiful substance of the composition BI_3, crystallizing from solution in carbon bisulphide in pearly tables, which melt at 43° to a liquid which boils undecomposed at 210°. When this substance is brought in contact with fused phosphorus an intense action occurs, the whole mass inflames with evolution of violet vapour of iodine. Red phosphorus also reacts with incandescence when heated in the vapour of boron iodide. The reaction may, however, be moderated by employing solutions of phosphorus and boron iodide in dry carbon bisulphide. The two solutions are mixed in a tube closed at one end, a little phosphorus being in excess, and the tube is then sealed. No external application of heat is necessary. At first the liquid is quite clear, but in a few minutes a brown solid substance commences to separate, and in three hours the reaction is complete. The substance is freed from carbon bisulphide in a current of carbon dioxide, the last traces being removed by means of the Sprengel pump. The compound thus obtained is a deep-red amorphous powder, readily capable of volatilization. It melts between 190° and 200°. When heated *in vacuo* it commences to volatilize about 170°, and the vapour condenses in the cooler portion of the tube in beautiful red crystals. Analyses of these crystals agree perfectly with the formula BPI_2. Boron phospho-di-iodide is a very hygroscopic substance, moisture rapidly decomposing it. In contact with a large excess of water, yellow phosphorus is deposited, and hydriodic, boric, and phosphorous acids formed in the solution. A small quantity of phosphoretted hydrogen also escapes. If a small quantity of water is used a larger deposit of yellow phosphorus is formed, together with a considerable quantity of phosphonium iodide. Strong nitric acid oxidizes boron phospho-di-iodide with incandescence. Dilute nitric acid oxidizes it to phosphoric and boric acids. It burns spontaneously in chlorine, forming boron chloride, chloride of iodine, and pentachloride of phosphorus. When slightly warmed in oxygen it inflames, the combustion being rendered very beautiful by the fumes of boric and phosphoric anhydrides and the violet vapours of iodine. Heated in contact with sulphuretted hydrogen, it forms sulphides of boron and phosphorus and hydriodic acid, without liberation

of iodine. Metallic magnesium when slightly warmed reacts with it with incandescence. When thrown into vapour of mercury, boron phospho-di-iodide instantly takes fire.

THE second phospho-iodide of boron obtained by M. Moissan is represented by the formula BPI. It is formed when sodium or magnesium in a fine state of division is allowed to act upon a solution of the di-iodide just described in carbon bisulphide; or when boron phospho-di-iodide is heated to 160° in a current of hydrogen. It is obtained in the form of a bright-red powder, somewhat hygroscopic. It volatilizes *in vacuo* without fusion at a temperature about 210°, and the vapour condenses in the cooler portion of the tube in beautiful orange-coloured crystals. When heated to low redness it decomposes into free iodine and phosphide of boron, BP. Nitric acid reacts energetically with it, but without incandescence, and a certain amount of iodine is liberated. Sulphuric acid decomposes it upon warming, with formation of sulphurous and boric acids and free iodine. By the continued action of dry hydrogen upon the heated compound the iodine and a portion of the phosphorus are removed, and a new phosphide of boron, of the composition B_5P_3, is obtained.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. James Hammond; two Pink-footed Geese (*Anser brachyrhynchus*), British, presented by Mr. Cecil Smith, F.Z.S.; two Tuberculated Tortoises (*Homopus femoralis*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two White-tailed Sea-Eagles (*Haliaëtus albicilla*), European, purchased.

OUR ASTRONOMICAL COLUMN.

THEORY OF ASTRONOMICAL ABERRATION.—An interesting point connected with astronomical aberration was raised by M. Mascart in a paper presented to the Paris Academy of Sciences on November 2. It would at first appear that if observations demonstrated that the constant of aberration had precisely the same value for all stars, the velocity of light in space must be uniform. This interpretation, however, seems open to objections. Eclipses of Jupiter's satellites furnish a method for determining the velocity of light in the space contained within the earth's orbit, and, as is well known, the results obtained in this manner agree very well with those deduced from experiments made on the surface of the earth. But astronomical aberration depends only upon the relation of the velocity of the observer to that of the light in the region occupied by the instrument, and is unaffected by any variations in the velocity of propagation of the light-waves between the object observed and the earth. A real difference in the constant of aberration given by different stars would therefore indicate that the velocity of light was not uniform in the parts of space traversed by the earth. From this reasoning, M. Mascart is led to conclude that the values derived from the experiments, direct and astronomical, made to determine the velocity of light, should be limited to the space contained within the terrestrial orbit. The induction is certainly a legitimate one, and it must be admitted that to consider the velocity of light in interstellar space as uniform is to rely entirely on hypothesis.

SUGGESTIONS FOR SECURING GREATER UNIFORMITY OF NOMENCLATURE IN BIOLOGY.[1]

COMPLAINTS are constantly being made, not only by laymen but by actual workers in science, of the increasing complexity of modern terminology. The fact is indisputable, but is it altogether to be regretted? Is it not rather the outward expression of fuller knowledge and clearer conceptions? If so, the complaints of those indolent persons who wish to gain a "general knowledge" of the subject with the least possible trouble to themselves are worthy of no more consideration than those of the landsman out yachting, of whom Mr. Hamerton writes:—

"You cannot speak of anything on board without employing technical terms which, however necessary, however unavoidable, will seem to him a foolish and useless affectation by which an amateur tries to give himself nautical airs. If you say 'the main-sheet,' he thinks you might have said more rationally and concisely, 'the cord by which you pull towards you that long pole which is under the biggest of the sails,' and if you say 'the starboard quarter,' he thinks you ought to have said, in simple English, 'that part of the vessel's side that is towards the back end of it and to your right hand when you are standing with your face looking forwards.'"

As a modern yacht or ironclad requires a more elaborate terminology than a fishing-boat or a trireme, so it is necessary that the exact morphology of to-day—to speak only of one branch of biology—should be weighted with a more extensive nomenclature than was required for the simpler comparative anatomy of former days. That many are repelled by the bristling outwork of more or less barbarous Greek and Latin compounds is undoubted, and is much to be regretted; but I quite fail to see that it can be avoided as long as we have to deal with a comparatively inflexible language like English. I would recommend anyone who is deeply impressed with the evils of the present system to try and translate a technical description of one of the ordinary students' types—say an earthworm or a crayfish—into "plain English" without loss of conciseness or lucidity.

I think it may be taken as axiomatic that whenever the bounds of knowledge are extended, either by the investigation of new problems or by the re-examination of old ones with the aid of improved methods and extended views, an elaboration of nomenclature is inevitable. Indeed, the introduction of an extended terminology, either because of the discovery of new facts or of the more accurate grouping of old ones, is a distinct gain; it emphasizes an actual advance in knowledge.

There are, however, certain undoubted evils connected with the introduction of new terms which must have troubled all of us at some time or other.

Two workers at a given subject living in different parts of the world invent each a terminology of his own. Each system is adopted by the inventor's own friends or countrymen, and no attempt is made by the general body of biologists to give either scheme official sanction—on grounds of priority or otherwise. In this respect systematists have a great advantage; if a given specific or generic name can be shown to have priority, it takes precedence of every other, however much more suitable the latter may be. Morphological names, on the other hand, always run the risk of being either ignored altogether, or ousted by others which, although no more appropriate, and perhaps considerably later in date, happen to be invented or adopted by some widely-read author.

New terms are sometimes proposed without a due sense of responsibility—on inadequate grounds or even from mere love of novelty; and, on the other hand, the conservative tendency leads to the continued employment of unsuitable terms when appropriate ones have been proposed in their place. New names are often casually introduced in the body of a large and highly technical paper, where they are certain to be seen by few; and, lastly, it frequently happens that such terms are inadequately defined.

Unfortunately this state of things can hardly be remedied by anything corresponding to the British Association's Rules, which have proved so useful in systematic zoology and botany. In these departments the appropriateness of a name is a matter of little importance, but in morphological nomenclature suitability is of far more importance than priority, and the most respectable and time-honoured terminology should never be allowed to stand in the way of one by which homologies, mutual relations, &c., are adequately expressed.

As morphology is essentially a progressive science, any attempt to draw up hard and fast rules on nomenclature is for the most part to be deprecated; the fittest must be allowed to survive. I think, however, that a few rules and definitions might be framed and afforded the official sanction, say, of the British, American, and Australasian Associations.

For instance, it is about time that we made up our minds as to what exactly we mean by *biology*, whether the whole science

[1] A Paper read before Section D (Biology) of the Australasian Association for the Advancement of Science, Christchurch, N.Z., by T. Jeffery Parker, B.Sc., F.R.S., Professor of Biology in the University of Otago, January 1891.

of living things, or that department which deals with the mode of life of organisms—habits, relation to the environment, &c.; the former use of the term is almost universal in English-speaking countries, but many of the leading German writers give it the other signification. Again, *morphology* and *anatomy* are terms of fundamental importance, and zoologists and botanists might surely agree upon a common definition for each. The same applies to other terms common to the two sub-sciences, *ovary* being the most flagrant example of divergence. To take one more example, the word *biogenesis* was introduced by Prof. Huxley to signify the origin of organisms from pre-existing organisms. Eimer, in his recent work on organic evolution, uses the term *biogenetic law* for the law that individual recapitulates ancestral development.

Another matter, which might certainly be settled once for all, is the meaning to be attached to adjectives and prefixes denoting position, such as dorsal and ventral, anterior and posterior, proximal and distal, mesial and lateral, epi-, hypo-, pre-, post-, &c. Such terms of position, although easy enough to apply in most cases, are constantly being misused; *epipubis* (for *pre-pubis*) is a modern and widely-used term; the dorsal and ventral roots of the spinal nerves are still frequently called *anterior* and *posterior*, and the great body-veins the *superior* and *inferior* venæ cavæ; and the botanical use of many terms of position (*e.g.* the *dorsal* and *ventral* sutures of a carpel) is absolutely meaningless.

Another step in the right direction would be the publication, under the auspices of the British, American, and Australasian Associations, the Anatomische Gesellschaft, and similar bodies, of a glossary of biological terms, in which the history of the word, its inventor, the precise sense in which he used it, and any subsequent changes of meaning it may have undergone, would be set forth. Such a glossary might, I think, be usefully arranged under somewhat similar headings to those employed in the *Zoologischer Jahresbericht*, the whole work being of course supplied with an alphabetical index. With a single responsible editor, and a sub-editor for each department, the work would not be one of insuperable difficulty.

An even more practicable suggestion than the last, and one which, although supplementary to, is not dependent upon it, is that in such publications as the *Zoological Record*, the Journal of the Royal Microscopical Society, and the *Zoologischer Jahresbericht*, there should be a record of new terms as well as of new species. The recorders who do the work of these publications with such fidelity and success, would hardly find their labours increased by noting down all the new terms used by the authors in their various departments, and placing them in a special list, each being accompanied by name of author, date, and definition. If this were done, we should have fewer instances both of useless synonyms and of identical words being employed for totally distinct things. I do not think, for instance, that the body-cavity of Peripatus would have been called a *pseudocœle* by Mr. Sedgwick, or a *metacœle* by Mr. Hatchett Jackson, if these writers had had the means of knowing that the former term had been previously applied by Dr. Burt Wilder to the so-called fifth ventricle of the mammalian brain, and the latter to the fourth ventricle.

Finally, matters would be very much improved if every author who finds himself obliged to coin a word would notify the fact in a conspicuous part of his paper, accompanying the term with an adequate definition. One has only to point to Allman's monograph on the Gymnoblastic Hydroids, or to Haeckel's Report on the Deep-Sea Medusæ, to give a practical instance of the advantage of such a practice.

My proposals for promoting greater uniformity of nomenclature in biology may therefore be summed up under three heads, as follows:—

1. The appointment of a strong international committee to define terms of general and fundamental importance, such as the subdivisions of biological science, terms common to zoology and botany, terms denoting position, &c.
2. The issue of an authoritative historical glossary.
3. The systematic record of new terms.

METEORIC IRON.

THE *Annalen des k.k. naturh. Hofmuseums*, No. 2 of vol. vi., contains a further contribution by E. Cohen and E. Weinschenk to their interesting studies on meteoric irons.

By treating comparatively large masses in the cold with very dilute hydrochloric acid (1 in 20) so that the process of solution was very slow, in some cases extending to several months, a residue is left from which it is found possible to isolate several more or less definite compounds, distinct from the freely soluble main mass of the meteorite.

It is in the portion insoluble in the highly dilute acid, which in some cases amounts to no more than 5 per cent. of the whole, that the main interest in analytical work on meteoric irons centres. The patience and care involved in the separation of its various constituents often find their reward in some interesting discovery. As a typical example of the constituents into which a meteorite may be separated by this treatment with dilute acid, it will suffice to quote the percentage numbers obtained in the case of a slice of the Magura iron. They are as follows:—

Nickel-iron which passed into solution	92·67	per cent.
Cohenite	4·00	,,
Tænite + jagged fragments	0·13	,,
Schreibersite	0·09	,,
Tænite + cohenite	2·93	,,
Non-magnetic residue	0·18	,,

In most meteoric irons the soluble portion consists to a large extent of a nickel-iron kamacite, which mainly constitutes the broad layers of the Widmanstätten figures seen on an etched polished surface. The authors are of opinion, from a comparison of various analyses, that this alloy has a constant composition represented by the formula $Fe_{14}Ni$.

Cohenite, which occurs in very brittle tin-white crystals, has at present been only found in the Magura iron. It was analyzed and described in a previous paper by Dr. Weinschenk, who found it to consist of a definite carbide of iron, nickel, and cobalt, having the composition represented by the formula $(FeNiCo)_3C$. Very similar crystals in the Wichita iron were found to have the composition represented by the formula $(FeNiCo)_4C$, analogous to the well-known spiegeleisen, Fe_4C. Cohenite corresponds to the carbide Fe_3C, which separates out in crystals when cast-iron is slowly cooled between 600° and 700°. Many points of resemblance such as this between meteoric and ordinary cast-iron appear to show that the conditions as regards temperature, &c., during their production must have been very similar in the two cases.

Tænite, occurring usually in thin silver-white lamellæ of great toughness between the broader layers of kamacite, is a nickel-iron, of which there appear to be two varieties, containing respectively about 65 and 73 per cent. of iron. Further analyses, however, are necessary in order to determine its true composition. The jagged and angular fragments of iron-black colour were analyzed, and found to consist of a nickel-iron containing about 7 per cent. of nickel, and were thus in all probability identical with kamacite.

The phosphor-nickel-iron schreibersite is generally found in large tabular crystals of tin-white colour. The new analyses show that its composition may be represented by the formula $(FeNiCo)_3P$. In some meteorites a phosphor-nickel-iron occurring in needles is found. This is the so-called rhabdite of Rose. Whether it is identical or not with schreibersite has not yet been decided, owing to the difficulty of obtaining pure material. A non-magnetic residue, consisting chiefly of transparent grains, the authors find is common in greater or less amount to most meteoric irons. In such residues a great variety of minerals have been identified with more or less certainty, such as diamond, cliftonite (a graphitic pseudomorph after diamond), quartz, tridymite, chromite, cordierite, garnet, corundum, pyroxenes both rhombic and monoclinic, &c.

The aim of the authors in the present investigation was to answer the following questions:—How widely distributed is cohenite? Are schreibersite and rhabdite definite compounds? Has kamacite a constant composition? Has tænite always the same physical and chemical properties? What is the composition of the jagged fragments so generally left undissolved after treatment of meteoric irons with dilute hydrochloric acid? How widely distributed are the transparent grains, as well as the diamond, cliftonite, &c.?

Unfortunately, owing to the fact that the present joint investigation had to be brought to a somewhat premature conclusion, a definite answer to all of these questions could not be given. We may, however, expect soon to hear more on the points still left undecided, as the promise is made that the gaps in the present investigation shall be filled up as soon as possible.

G. T. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The first election to a Geographical Studentship will be held at the end of Hilary Term 1892. The student at the time of his election must have passed all the examinations for his B.A. degree in the University of Oxford, but must not be of more than eight years' standing from matriculation. Previous to his election he must have attended the lectures of the Reader in Geography in at least two terms. Information as to the conditions of tenure may be obtained from the Reader in Geography.

The Report of the Delegacy of Non-Collegiate Students was presented to Convocation on Wednesday. It shows that the list of matriculations is rather larger than in the preceding year, but the total number of undergraduates has somewhat decreased. The total number on the books (440) is the largest which has yet been reached. Thirty-six took the B.A. degree, and nineteen the M.A. during the year. The Delegates notify that they admit, without examination, students in any special branch of study who do not desire to pass through the Arts course, and can show evidence of fitness for their special subject. Sixteen students have availed themselves of this privilege during the year. The balance-sheet appended shows that the financial condition is satisfactory. The total receipts exceeded the expenditure by £550, and the accumulated balance in the hands of the Delegacy at the close of the year was £2284.

CAMBRIDGE.—Mr. J. Macalister Dodds, of Peterhouse, has been elected Chairman of the Examiners for the Mathematical Tripos, Part I.

A petition from 2689 persons residing in New Zealand has been received by the Vice-Chancellor, praying that the Senate will grant degrees to properly qualified women. The signatories include Sir George Grey, K.C.B., formerly Governor of New Zealand, most of the Ministers of the Colonial Government, and many professors and graduates of the University of New Zealand.

Lord Walsingham, F.R.S., High Steward of the University, offers annually a gold medal to B.A.'s of not more than two years' standing for the best monograph or essay giving evidence of original research on any botanical, geological, or zoological subject; zoology being understood to include animal morphology and physiology, and an essay on any subject of chemical physiology being valued according to its physiological rather than its chemical importance.

MR. R. W. STEWART, B.Sc. (Lond.), has been appointed Assistant Lecturer and Demonstrator in Physics at the University College of North Wales, Bangor.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for October contains:—A short memoir of the late Prof. W. Ferrel, by Prof. A. McAdie, with a complete list of his scientific contributions, from 1853 to 1891; his last paper, which appeared in our columns in April 1891, was entitled "The High-pressure Area of November 1889 in Central Europe."—The mineral waters of Ypsilanti and other places in Michigan, by Dr. E. N. Brainerd.—Cloud observations at sea, by Prof. C. Abbe. This is a preliminary report relative to the principal features of the work done by him during the recent cruise of the *Pensacola* to the West Coast of Africa. A number of experiments were made to determine the relative speed and direction of movement of the various strata of air, by means of clouds and small balloons. The experiments showed that the use of balloons is practicable both on sea and land, and gives accurate results. The following are some of the results of the author's observations: the vertical circulation increases and the horizontal circulation diminishes in the doldrums; the horizontal movement is a maximum at high latitudes; the bases of the cumuli are lower and their tops higher in the low latitudes; if there be any general east wind in the upper regions at the doldrum it is above the clouds, and therefore not observable.—The last article is by Dr. Leudet, on the action of climates at elevated stations on diseases of the chest.

Bulletin de l'Académie des Sciences de St. Pétersbourg, new series, vol. ii., No. 1.—On the scales of *Holoptychius* found in Russia, by Dr. Rohon (French). The histology of the same is described, as also two new species: *Hol. varius* and *Hol. superbus*.—Ichthyological notes from the Museum of the Academy, by S. Herzenstein, being a description of the following new species: *Cottus nivosus*, *Centridermichthys alcicornis*, *Hypsagonus gradiens*, *Stichæus grigoriewi*, *St. dictyogrammus*, *Chirolophus japonicus*, *Pleuronectes obscurus*, *Pl. japonicus*, *Pl. bicoloratus* (incompletely described by Basilewsky), *Hippoglossus grigoriewi*, *Alburnus charusini*, and *Nemachilus kuschakewitschi*.—On the extraordinary phenomena presented by the great comet of 1882, by Th. Bredichin. After having given in a preceding paper his reasons for considering the interior tube of that comet as an anomalous tail, the author applies the same explanation to the exterior tube.—On two new laws of celestial mechanics, by H. Struve. In addition to the previously communicated results of observations made on the satellites of Saturn with the 30-inch refractor, Prof. Struve points out the remarkable relations which exist between the satellites Mimas and Tethys on the one side, and Enceladus and Dione on the other side. The observations of Mimas have shown that its orbit has an inclination of 1° 26′ on the equator of Saturn, and that its nodes have a motion of 1° every day, so that by the end of the year the orbit returns to its previous position; moreover, a considerable acceleration has been noticed in the rotation of Mimas during the last few years. From these facts M. Struve deduces the following law:—"Four times the average movement of Tethys, minus twice the average movement of Mimas, is always equal to the sums of the average movements of the nodes of the orbits of Mimas and Tethys on the equator of the planet." The same law may also be expressed in this way:—"(1) The conjunctions of Mimas and Tethys always take place about a point which is situated halfway between the ascending nodes of their orbits on the equator of Saturn. They may move off this point for about 48°, and this libration is performed in sixty-eight years. (2) The conjunctions of Enceladus and Dione always coincide with the perisaturn of Enceladus, or, at least, they must oscillate around this point." Several important conclusions relative to the mass of Rhea and that of the rings may be deduced from these laws.—On the genus *Obolus* (Eichwald), by A. Mickwitz.—On a personal equation in photometric observations of stars, by E. Lindemann.—The mammals of the Gan-su expedition of 1884–87, by Eug. Büchner (German). The few species of this very interesting fauna which have been brought to St. Petersburg, are described, the remainder being kept in the Museum of Irkutsk.—On the rotation of Jupiter, by A. Belopolsky (in German). From a perusal of all available data, the author finds the rotation-period to be equal to 9h. 55m. in the latitudes from 10° to 45°, while in the zone 0° to 5°, it is only 9h. 50m.—On the Ammonites of the Artinsk strata, by A. Karpinsky (German). The collection is derived from North-East Russia; the new species are: *Pronorites postcarbonicus*, *Pr. praepermicus*, *Parapronorites tenuis*, *Gastrioceras suessi*, *Agathiceras uralicum*, *Popanoceras krasnopolskyi*, and *Thalassoceras gemmellaroi*.—On a new process for separating iron-oxide from aluminium, by F. Beilstein and R. Lüther.—Chemical notes, by N. Beketoff.—On the use of incandescent light for self-registering instruments, by H. Wild.—On artificial amphibolite, by K. Khrustschoff.

IN the *Botanical Gazette* for September and October, Mr. T. Holm continues his series of articles on the minute comparative anatomy of American grasses. Brief abstracts are given of the botanical papers read at the Washington meeting of the American Association for the Advancement of Science, and at that of the Botanical Club of the same Association. Other papers are chiefly of interest to American botanists.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, November 3.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the months of June, July, August, and September, 1891, and called attention to certain interesting accessions which had been received during that period.—The following objects were exhibited:—(1) On behalf of Mr. F. E. Blaauw, a stuffed specimen of a young Wondrous Grass-Finch (*Poephila mirabilis*), bred in captivity at his house in Holland; (2) on behalf of Prof. E. C. Stirling, a water-colour drawing of the new

Australian Mammal *Notoryctes typhlops*; (3) by Mr. G. A. Boulenger, an Iguana with the tail reproduced; (4) by Mr. R. Gordon Wickham, a very fine pair of horns of the Gemsbok (*Oryx gazella*) from Port Elizabeth, South Africa; and (5) by Dr. Edward Hamilton, a photograph of an example of the Siberian Crane (*Grus leucogeranus*), shot on the island of Barra, Outer Hebrides, in August last.—Mr. R. Lydekker gave a description of some Pleistocene Bird-remains from the Sardinian and Corsican Islands. These belonged mostly to recent forms, but to genera and species which in several instances had not been found fossil. They showed rather more of an African character than the present avifauna of these islands.—Mr. R. Lydekker also read some notes on the remains of a large Stork from the Allier Miocene. These remains were referred to the genus, closely allied to *Ciconia*, lately named *Pelargopsis*, but which (that term being preoccupied) it was now proposed to rename *Pelargoides*.—Mr. R. Lydekker also exhibited and made remarks on the leg-bones of an extinct Dinornithine Bird from New Zealand, upon which he proposed to base a new species allied to *Pachyornis elephantopus* (Owen), and to call it, after the owner of the specimens, *Pachyornis rothschildi*.—Dr. A. Günther, F.R.S., read a description of a remarkable new Fish from Mauritius belonging to the genus *Scorpæna*, which he proposed to call *Scorpæna frondosa*.—A communication was read from Mr. Roland Trimen, containing an account of the occurrence of a specimen of the scarce Fish *Lophotes cepedianus*, Giorna, at the Cape of Good Hope.—A communication was read from the Hon. L. W. Rothschild, giving a description of a little-known species of *Papilio* from the Island of Lifu, Loyalty Group.—Mr. R. J. Lechmere Guppy read some remarks on a fine specimen of *Pleurotomaria* from the island of Tobago.—A communication was read from Mr. L. Péringuey, giving an account of a series of Beetles collected in Tropical South-western Africa by Mr. A. W. Eriksson.

Entomological Society, November 4.—Dr. D. Sharp, F.R.S., Vice-President, in the chair.—Mr. W. F. Kirby exhibited a series of a very dark-coloured form of *Apis* reared by Mr. John Hewitt, of Sheffield, from bees imported from Tunis, and which he proposed to call "Punic bees."—Mr. C. G. Barrett exhibited five melanic specimens of *Aplecta nebulosa*, reared from larvæ collected in Delamere Forest, Cheshire, and described in the Proceedings of the Lancashire and Cheshire Natural History Society as *A. nebulosa*, var. *Robsoni*. Mr. Barrett also exhibited a beautiful variety of *Argynnis aglaia*, taken in Norfolk by Dr. F. D. Wheeler, and two specimens of *Lycæna argiades*, taken in August 1885, on Bloxworth Heath, Dorsetshire.—Mr. H. St. John Donisthorpe exhibited a collection of Coleoptera, comprising about thirty-six species, made in a London granary in 1890 and 1891. The genera represented included *Sphodrus*, *Calathus*, *Quedius*, *Creophilus*, *Omalium*, *Trogosita*, *Silvanus*, *Lathridius*, *Dermestes*, *Anthrenus*, *Ptinus*, *Niptus*, *Anobium*, *Blaps*, *Tenebrio*, *Calandra*, and *Bruchus*.—Mr. A. B. Farn exhibited a series of specimens of *Eubolia lineolata*, bred from a specimen taken at Yarmouth. The series included several remarkable and beautiful varieties, and the size of the specimens was much above the average.—The Rev. Dr. Walker exhibited specimens of *Argynnis ino* and *A. pales*, from Norway.—Mr. B. A. Bower exhibited, for Mr. J. Gardner, specimens of *Nephopteryx splendidella*, H. S., *Botys lupulinalis*, Clk., and *Bryotropha obscurella*, Hein., taken at Hartlepool.—Mr. R. Adkin exhibited two very dark specimens of *Peronea cristana*, from the New Forest.—Colonel C. Swinhoe exhibited, and remarked on, types of genera and species of moths belonging to the *Tineina*, all of which had been described by Walker, and placed by him amongst the *Lithosidæ*.—Mr. H. Goss exhibited specimens of *Callimorpha hera*, taken by Major-General Carden in South Devon in August last, and observed that the species appeared to be getting commoner in this country, as General Carden had caught seventeen specimens in five days. Mr. Goss said that the object of the exhibition was to ascertain the opinion of the meeting as to the manner in which this species had been introduced into this country. A discussion on the geographical distribution of the species ensued, in which Mr. G. T. Baker, Colonel Swinhoe, Mr. McLachlan, Mr. Verrall, Captain Elwes, Mr. Barrett, Mr. Fenn, and others took part.—Mr. C. J. Gahan contributed a paper entitled "On South American Species of Diabrotica," Part III.—Mr. McLachlan contributed a paper entitled "Descriptions of New Species of Holopthalmous *Ascalaphidæ*."—Mr. W. L. Distant communicated a paper entitled "Descriptions of Four New Species of the Genus *Fulgora*."—Mr. F. Enock read a paper entitled "Additional Notes and Observations on the Life-history of *Atypus piceus*." Every detail in the life-history of this spider was most elaborately illustrated by a large number of photographs, made by Mr. Enock from his original drawings, and shown by means of the oxy-hydrogen lantern. A discussion followed, in which Mr. C. O. Waterhouse, Dr. Sharp, Mr. G. C. Champion, the Rev A. E. Eaton, and Mr. P. Crowley took part.

Anthropological Institute, November 10.—Dr. Edward B. Tylor, F.R.S., President, in the chair.—Mr. Francis Galton exhibited, on behalf of Lady Brooke, a photograph of a human figure carved on a rounded sandstone rock in Sarawak; the rock is about twelve feet in height, and the sculpture is in high relief and of the size of life. Mr. Galton also exhibited some imprints of the hand, by Dr. Forgeot, of the Laboratoire Criminale, Lyon.—Dr. Tylor read a paper on the limits of savage religion. In defining the religious systems of the lower races, so as to place them correctly in the history of culture, careful examination is necessary to separate the genuine developments of native theology from the effects of intercourse with civilized foreigners. Especially through missionary influence since 1500, ideas of dualistic and monotheistic deities, and of moral government of the world, have been implanted on native polytheism in various parts of the globe. For instance, as has lately become clear by the inquiries of anthropologists, the world-famous Great Spirit of the North American Indians arose from the teachings of the Jesuit missionaries in Canada early in the seventeenth century. This and analogous names for a Supreme Deity, unknown previously to native belief, have since spread over North America, amalgamating with native doctrines and ceremonial rites into highly interesting but perplexing combinations. The mistaken attribution to barbaric races of theological beliefs really belonging to the cultured world, as well as the development among these races of new religious formations under cultured influence, are due to several causes, which it is the object of this paper to examine: (1) direct adoption from foreign teachers; (2) the exaggeration of genuine native deities of a lower order into a God or Devil; (3) the conversion of native words, denoting a whole class of minor spiritual beings, such as ghosts or demons, into individual names, alleged to be those of a Supreme Good Deity or a rival Evil Deity. Detailed criticism of the names and descriptions of such beings in accounts of the religions of native tribes of America and Australasia was adduced, giving in many cases direct proof of the beliefs in question being borrowed or developed under foreign influence, and thus strengthening the writer's view that they, and ideas related to them, form no original part of the religion of the lower races. The problems involved are, however, of great difficulty, the only hope of their full solution in many cases lying in the researches of anthropologists and philologists minutely acquainted with the culture and languages of the districts; while such researches will require to be carried out without delay, before important evidence, still available, has disappeared.

PARIS.

Academy of Sciences, November 9.—M. Duchartre in the chair.—On the use of chronophotography for the study of machines constructed for aërial locomotion, by M. Marey. It is known that, in the case of a plane moving in a fluid medium, the centre of pressure only coincides with the centre of figure if the plane be normal to the direction of its motion; but if the plane makes an angle with its trajectory, the centre of pressure occurs in advance of the centre of figure to an extent which increases as the plane forms a more acute angle with the direction of motion, and as its velocity of translation is increased. This principle is strikingly illustrated by some photographs of a specially constructed falling body taken at intervals of a twentieth of a second. The body first described a sensibly parabolic curve, it then rose slightly, and passed over a convex curve before reaching the ground. The figure accompanying the paper shows clearly that the inflexions of the body's trajectory depend on the variations of its velocity, and the inclination of its surface with respect to the direction of motion.—On the laws of the intensity of light emitted by phosphorescent bodies, by M. Henri Becquerel. The author develops formulæ to represent the relation between the intensities of light emitted by phosphorescent bodies and the duration of illumination, and compares the results of some of

his father's observations with those obtained by calculation. The agreement of the two sets of numbers is very close, even when the intensity was taken some thirty minutes after the body had been emitting light. A relation is also established between the intensity and the time that the body was exposed to light.—Study of boron phospho-iodides, by M. Henri Moissan. (See Notes, p. 67.)—M. Haton de la Goupillière made some remarks on the paper read by Sir William Thomson before the Royal Society on April 9, "On Electrostatic Screening by Gratings, &c.," saying that he had published some similar results in 1859.—Experimental determination of the velocity of propagation of electro-magnetic waves, by M. R. Blondlot. Experiments have been made between wave-lengths 8·94 and 35·36 metres, and the results show that all electrical undulations have a velocity of propagation of about 297,600 kilometres per second.—On algebraic integrals of the differential equation of the first order, by M. Autonne.—On surfaces with rational generators, by M. Lelieuvre.—Theory of turbo-machines, by M. Rateau.—A simple method of verifying the centres of the object-glasses of microscopes, by M. C. J. A. Leroy.—On the existence of acid or basic salts of monobasic acids in very dilute solutions, by M. Daniel Berthelot. The author has studied very dilute solutions near the point of neutralization, using HCl and baryta water at a concentration of 0·01 equivalent per litre, by the method of measuring the electric conductivities. He concludes that acid and basic salts are not destroyed by dilution, even very dilute solutions containing traces undecomposed.—On the formation of hydrates at high temperatures, by M. G. Rousseau.—On a double chloride of copper and lithium, by M. A. Chassevant. A substance of the composition $2\{CuCl_2.LiCl\} + 5H_2O$ has been obtained. It is decomposed by water, but is soluble to a red-brown solution in a concentrated solution of lithium chloride from which it may be recrystallized.—Researches on digitaleïn, by M. J. Houdas.—On isocinchonines, by MM. E. Jungfleisch and E. Leger.—Estimation of fats in milk products, by MM. Lezé and Allard.—Ptomaïnes extracted from urine in cases of some infectious maladies, by M. A. B. Griffiths. The ptomaïne from scarlet fever has the composition $C_5H_{12}NO_4$, that from diphtheria $C_{14}H_{17}N_2O_6$; they have also been prepared from pure cultures on peptonized gelatine of *Micrococcus scarlatinæ* and *Bacillus diphtheriæ* respectively. The ptomaïne from the urine of a case of mumps has the constitution $NH:C(NH_2).N(C_3H_7).CH_2.CO_2H$. None of the three ptomaïnes described are constituents of normal urine.—On the exterior form of the muscles of man with respect to the movements executed (experiments made by chronophotography), by M. G. Demeny.—On the formation of the peripheral nervous system of vertebrates, by M. P. Mitrophanow.—On the effects of parasitism on *Ustilago antherarum*, by M. Paul Vuillemin.—Meteorological observations made at Rodez, by M. des Vallières.

AMSTERDAM.

Royal Academy of Sciences, October 31.—Prof. van de Sande Bakhuyzen in the chair.—Prof. P. H. Schoute offered some general remarks on Lemoine's two problems of stamps: In how many different ways a ribbon of p stamps and a rectangular sheet of pq stamps can be folded up in one? (compare vol. i. p. 120 of the "Théorie des Nombres" of E. Lucas). He reduced the first problem to a question in the theory of permutations, gave the number x_p of its solutions up to $p = q$, and showed why the number $x_{p,q}$ of the solutions of the second problem must surpass the expression $\binom{p+q-2}{p-1} x_p x_q$.—Prof. B. J. Stokvis made a contribution to our knowledge of mutual antagonism and the combined action of mutual antagonists. In experimenting on the isolated and freely pulsating frog's heart, he stated that digitaline on the one side, and muscarine (or chinine) on the other, were to be considered as mutual antagonists for this organ, and displayed their antagonistic action, whichever of the two might be applied first. In another series of experiments he studied the action of muscarine and digitaline flowing at the same time with the nourishing blood through the isolated frog's heart, and found that the greatest antagonistic action, for instance of digitaline, was displayed when very dilute solutions (1 : 25,000 or 1 : 33,333) were applied at the same time as moderately strong solutions of muscarine. Finally, he stated that the isolated frog's heart recovered much faster and much more easily by normal blood when it was previously poisoned by muscarine and digitaline combined than when it was poisoned by the same or even a lower dose of muscarine alone.—MM. S. Hoogewerff and W. A. van Dorp gave an account of the action of an aqueous solution of ammonia on phthalic chloride. If care is taken to keep the liquids cool in mixing, about 40 per cent. of the weight of the chloride is converted into orthocyanobenzoic acid, $C_6H_4 \begin{matrix} CN \\ COOH \end{matrix}$.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Land of the Lamas, W. W. Rockhill (Longmans).—Amphimixis; oder Die Vermischung der Individuen: A. Weismann (Jena, Fischer).—Primitive Culture; 2 vols., 3rd edition, revised: Dr. E. B. Tylor (Murray).—Memoirs of the Geological Survey of India, vol. xxiii. Geology of the Central Himálayas: J. L. Griesbach (Calcutta).—L'Homme dans la Nature: P. Topinard (Paris, Alcan).—Outlines of Physiological Chemistry, 2nd edition: F. C. Larkin and R. Leigh (Lewis).—My Personal Experiences in Equatorial Africa: T. H. Parke (Low).—An Introduction to the Theory of Value: W. Smart (Macmillan).—Quantitative Chemical Analysis: F. Clowes and J. B. Coleman (Churchill).—A Hand-book of Industrial Organic Chemistry: S. P. Sadler (Lippincott).—Farm Crops; J. Wrightson (Cassell).—Our Common Birds and how to Know Them: J. B. Grant (Gay and Bird).—The Microscope and its Relations, 7th edition: Dr. W. H. Dallinger (Churchill).—How to Use the Aneroid Barometer: E. Whymper (Murray).—Beobachtungen der Russischen Polar-station auf Nowaja Semlja, 1 Theil, Magnetische Beobachtungen: K. Andrejeff (St. Petersburg).—Selected Essays of Arthur Schopenhauer: E. B. Bax (Bell).—About Ceylon and Borneo: W. J. Clutterbuck (Longmans).—With Axe and Rope in the New Zealand Alps: G. E. Mannering (Longmans).—The Microscope and Histology, Part 1, The Microscope and Microscopical Methods: S. H. Page (Ithaca, N. Y.).—Anthropogenie oder Entwickelungsgeschichte des Menschen, 2 vols.: E. Haeckel (Leipzig, Engelmann).

PAMPHLET.—A Memoir on the Coefficients of Numbers: B. Seal (Calcutta).

SERIALS.—Bacteriological World, vol. i. No. 10 (Battle Creek, Mich.).—Proceedings of the Aristotelian Society, vol. i., No. 4, Part 2 (Williams and Norgate).—Himmel und Erde, November (Berlin, Paetel).—Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg, nouvelle série ii. (xxxiv.) (St. Pétersbourg).—Harvard University Bulletin, No. 50.

CONTENTS.